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SHOP PRACTICE

MACHINE AND TOOL DESIGN

MANAGEMENT PROBLEMS

DEPARTMENTS

MANY WITH

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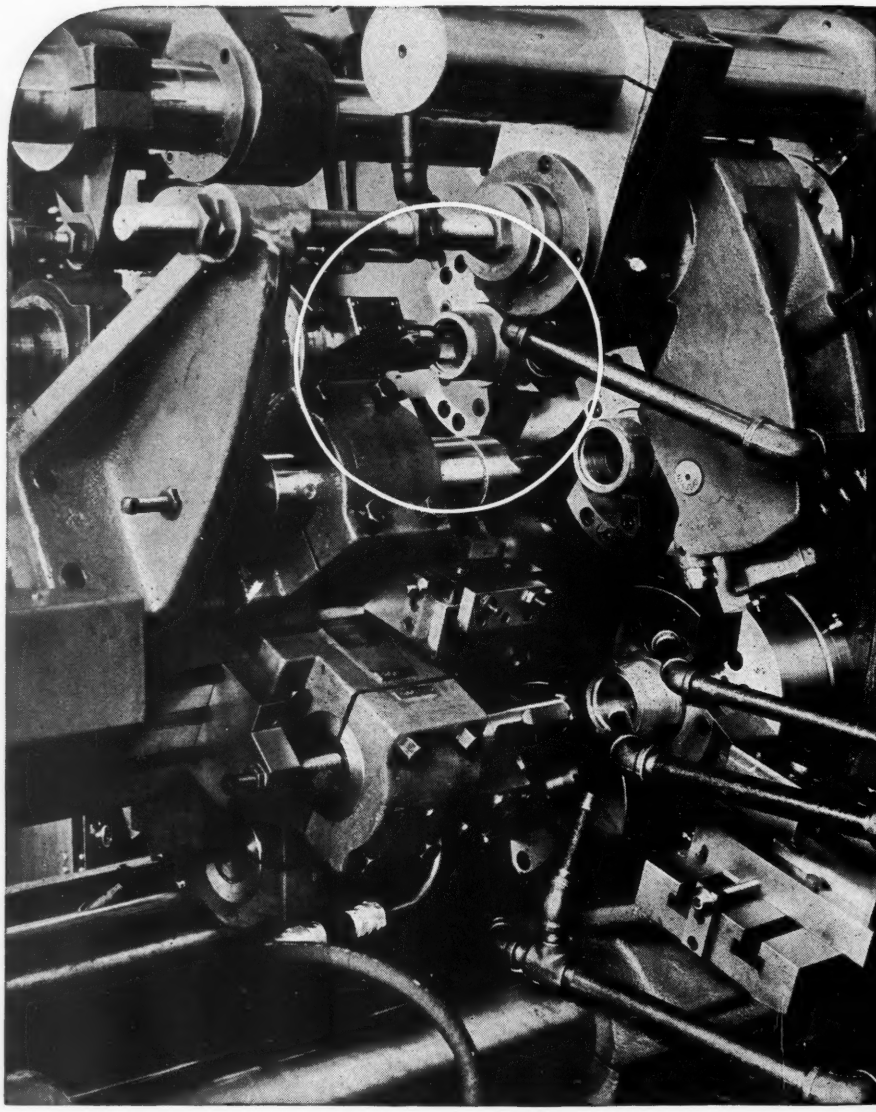

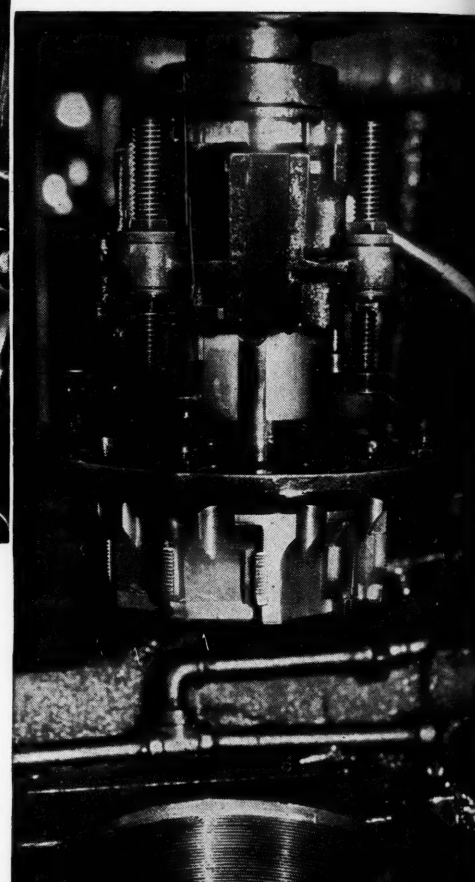

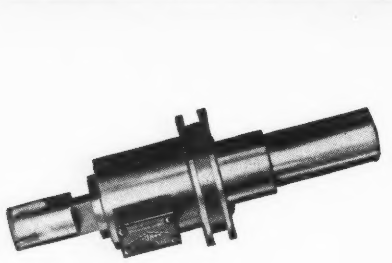

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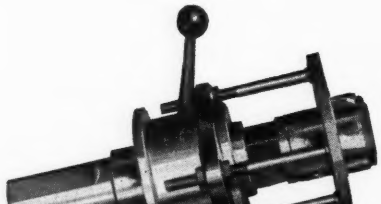

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The LANDIS *Machine* COMPANY

THE WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF

MACHINERY
MAY, 1950
Vol. 56 No. 9

Cost-Cutting Methods in Piston-Ring Production

By GEORGE H. DeGROAT

WEAR resistance, high tensile strength, a high degree of elasticity, and great impact strength are required in piston-rings used in aircraft, automotive, and industrial engines. To produce a wide range of various types of rings having these characteristics, rigid control is exercised over materials and methods, and extensive use is made of special tools and automatic machinery at the Piston-Ring Division of Koppers Co., Inc., Baltimore, Md., as described in the following.

Many of the rings made in this plant are centrifugally cast in cylindrical form from a high-strength iron alloy developed by the Koppers Co. The charge used to produce this material, which is known as "K-Spun," is melted in 250-, 330-, and 650-pound capacity electric induction furnaces, by means of which very accurate control is obtained over the chemical composition. Since metal removed in machining must be held to a minimum for production economy, dimensions of the outside and inside diameters of the cast cylinders are closely maintained providing uniform machining stock allowances.

The outside diameters are determined by the dimensions of the permanent molds in which the cylinders are cast, while the inside diameters are controlled by weighing the molten metal as it is poured from the furnaces. The pouring ladles are placed on special scales installed in a pit adjacent to the melting furnaces. By holding the weight of the charge to a tolerance of 1/2 pound,

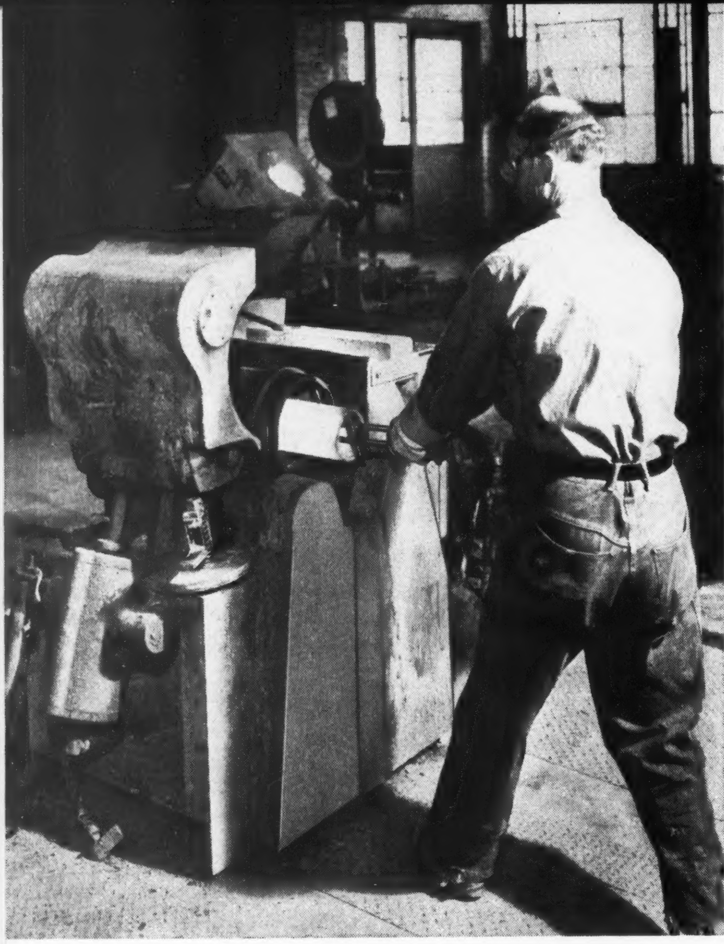


Fig. 1. Centrifugally cast "K-Spun" cylinders are removed from molds in the casting machines and allowed to cool in still air at room temperature

an accuracy of 1/32 inch is obtained on the inside diameter of a cast cylinder.

The automatically timed centrifugal casting machines are equipped with variable-speed controls that provide a range of speeds from 300 to 1600 R.P.M., since castings of different sizes require various spinning speeds, depending upon the wall thickness and the diameter. Inasmuch as the wall thickness seldom exceeds 1/2 inch, spinning cycles are relatively short. Upon the completion of a spinning cycle, the back plate of the mold is removed, allowing access to the solidified casting, which is taken from the mold, as shown in Fig. 1, and cooled in still air at room temperature.

The cylinders are very brittle and unmachinable as cast. Before any machining operations are performed, therefore, they are taken from the foundry to the heat-treating department for annealing. Racks containing a number of cylinders are placed in large electric furnaces, where the work is annealed in a carburizing atmosphere at a temperature of 1750 degrees F. for four hours. This is followed by an air blast quench, leaving the cylinders with a hardness of 96 to 105 Rockwell B. Fig. 2 illustrates a rack of cylinders being removed from a furnace at the end of a heating cycle.

The first machining operation, which is performed in Sundstrand automatic lathes, consists of rough-turning the outside diameter of the cylinders to obtain a uniform degree of roundness. In these machines, the work is held between centers in air-operated fixtures while gang set-ups of carbide tools turn the outside diameter within plus or minus 0.005 inch tolerance.

The main purpose of this operation is to prepare the castings for semi-finish-machining in special boring, turning, and cutting-off machines. A battery of electrically controlled, hydraulically operated automatic lathes, especially designed and built by the Gisholt Machine Co., Madison, Wis., is used to produce rings ranging from 2 1/4

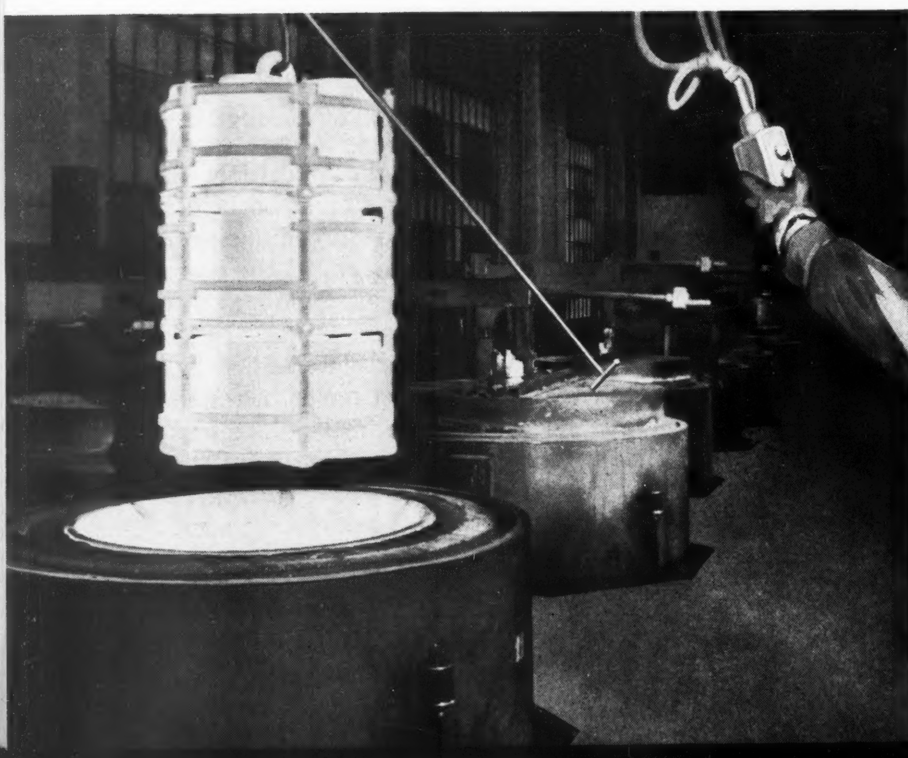


Fig. 2. Cast cylinders being removed from a large electric furnace in which they were annealed in a carburizing atmosphere at a temperature of 1750 degrees F. for four hours

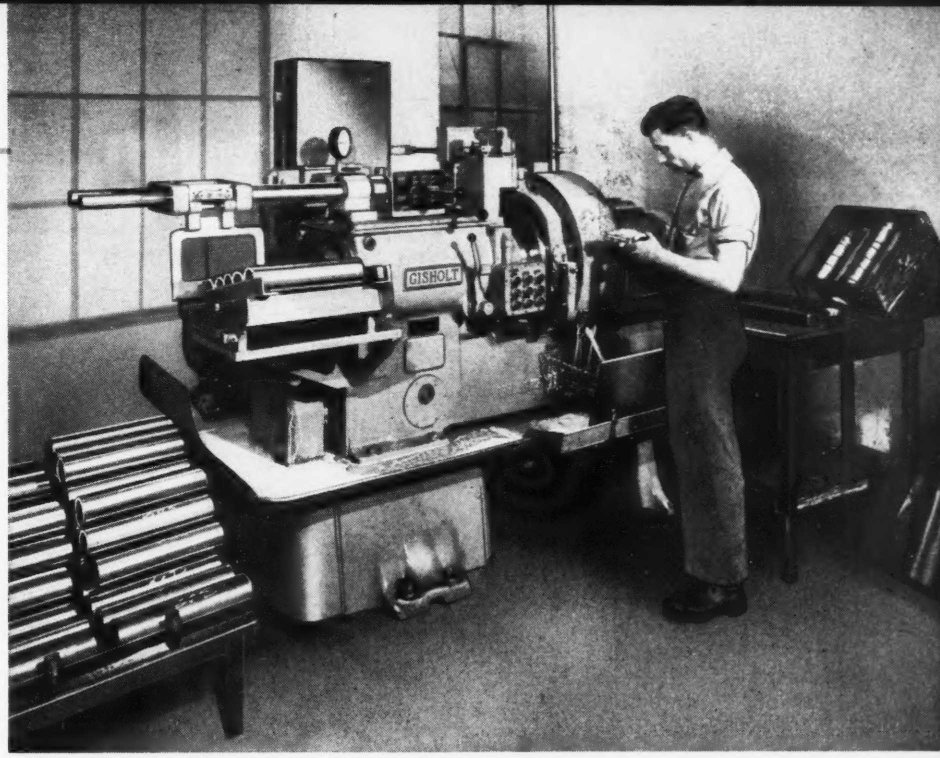


Fig. 3. After the cylinders have been rough-machined, semi-finish-machined piston-rings are produced in special electrically controlled, hydraulically operated automatic lathes that bore and turn the cylinders and then cut off the rings

to 6 inches in diameter from these castings. One of these machines is shown in Fig. 3, where it can be seen that the cylinders have been manually loaded into a ramp at the left-hand end of the machine. From the ramp they roll into line with a pusher plate, which is actuated hydraulically from an overhead bar to advance them through the spindle one at a time.

As the cycle starts, a Belleville spring type, three-jaw chuck automatically opens by contact of a roller with two hydraulically operated yokes, and the work is pushed through the spindle. A vertical stop-plate *A*, Fig. 4, moves into position and acts as a guide to regulate the length of the casting extending through the spindle. When the work has been fed through the spindle the proper amount, the jaws clamp the part and the stop-plate retracts. The front slide, carrying carbide-tipped tools, then moves in to turn and bore the casting at the same time. About 1/32 to 1/16 inch of stock is removed from a side in turning and 1/8 to 1/4 inch in boring, depending on the wall thickness, using a cutting speed of approximately 175 surface feet per minute.

When this has been done, the front slide moves back and the rear slide *S*, Fig. 5, moves in to cut off the rings at a feed of 0.003 inch per revolution. The face width of the rings determines the number of cut-off tools *B*, Fig. 4, carried on this slide, which is actuated by a rack and pinion to obtain a low feeding rate. Generally, from seven to twelve carbide-tipped parting tools are used, holding the face widths to a tolerance of plus or minus 0.003 inch.

These tools are arranged at an angle in the holder, so that the rings are cut off one at a time. To eliminate the possibility of rings being caught between the blades, the tools are fed through a window in a stripper plate *C*. As the rings are cut off, they fall into a chute and are collected in a basket at the front of the machine. As soon

Fig. 4. The Gisholt lathe shown in Fig. 3 utilizes a gang set-up of carbide tools (B) which engage the work through a stripper plate (C). The casting is automatically positioned by a stop (A)

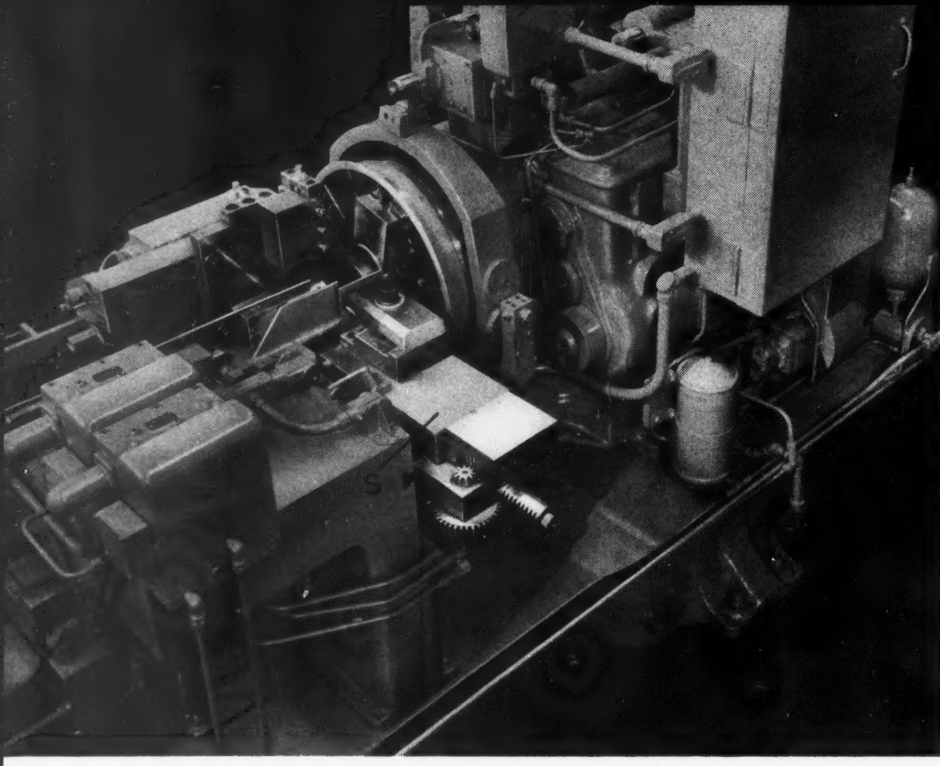


Fig. 5. The rear tool-slide (S) on this boring, turning, and cutting-off machine is actuated by a rack and pinion to obtain a low feeding rate for the parting tools

as the last ring has been cut off, all the tools retract, the chuck jaws are reopened, and the cycle starts over again. The cycle is continuous and requires only that the machine operator keep the inclined ramp filled with rough-turned cylinders and remove the finished parts from the basket at the end of the operation.

Another unusual boring, turning, and cutting-off machine designed for piston-ring manufacture by the Gisholt Machine Co. is shown in the heading illustration. This special "Simplimatic" is used for semi-finish-machining Diesel-engine and other piston-rings ranging in diameter from 6 to 14 inches. In this electrically controlled, automatic machine the cast cylinders are loaded manually in a Belleville six-jaw, spring-operated chuck, the full length of the cast cylinder extending back into the spindle. When the cycle is started, the chuck jaws open and an air-operated pusher-bar from within the spindle moves the cylinder out to the proper length, whereupon it engages a positive stop. The jaws then automatically clamp the work in this position, after which the cam-operated front tool-slide carrying carbide-tipped tools simultaneously turns and bores the cylinder.

Following this operation, the front slide retracts and the rear slide advances to present carbide parting tools arranged in the same manner as in the previously described machine. The chuck jaws then reopen and the cycle starts again. When the short piece of casting used for chucking can no longer reach the stop, the machining cycle automatically stops. The cut-off tools may be seen at *A* in Fig. 6 behind the stripper plate *B*. The boring tool is shown at *C*, the turning tool at *D*, and the pusher-bar inside the spindle at *E*.

Approximately 1/8 inch of stock is removed from a side in turning, and 3/16 inch in boring, using a cutting speed of about 175 surface feet

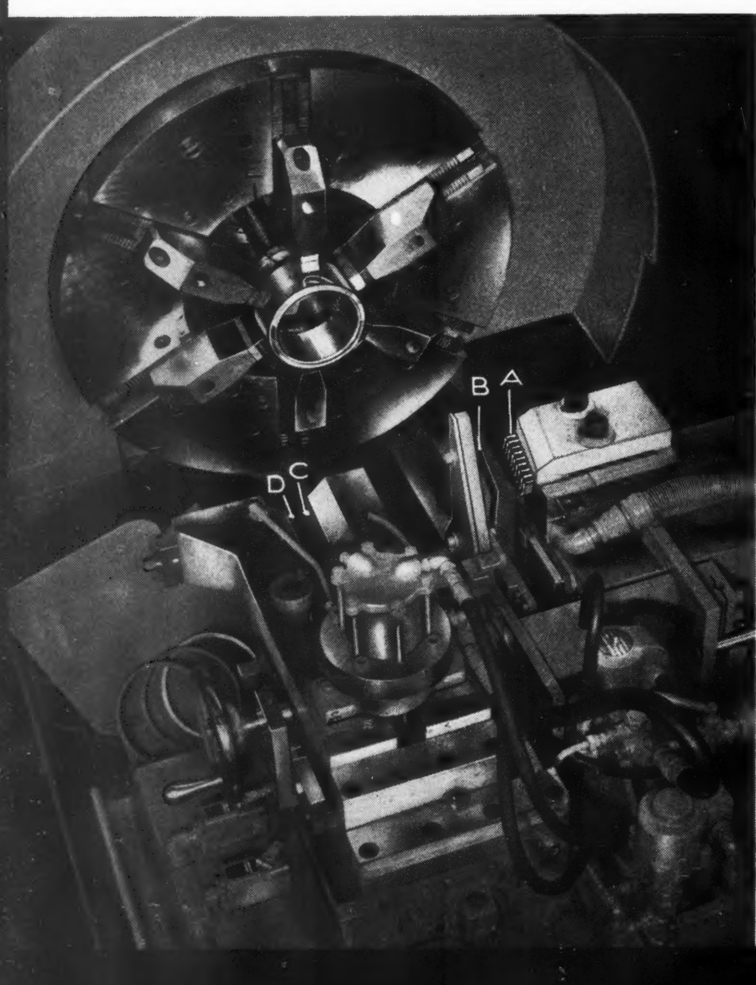


Fig. 6. In the machine shown in the heading illustration, carbide parting tools (A) are used for cutting off piston-rings one at a time through a stripper plate (B). A carbide boring tool is shown at (C) and a turning tool at (D)

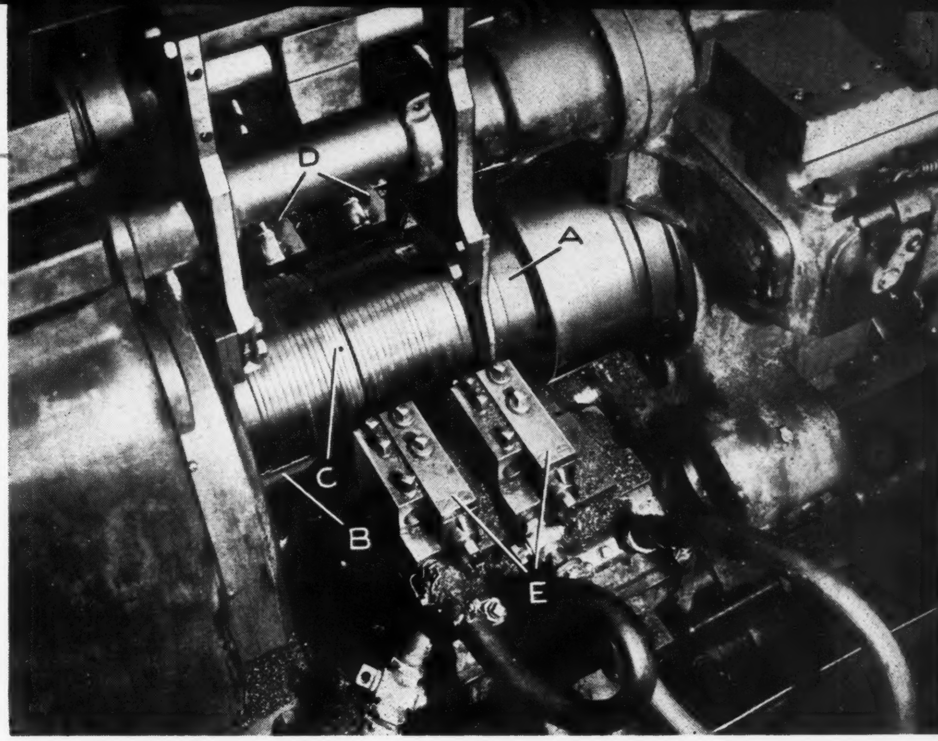


Fig. 7. Special Fay automatic lathes are employed for finish turning and boring large piston-rings. The rings are stacked between end plates, one of which can be seen at (A), and centered by means of a work-cradle (B)

per minute. Bore dimensions are held to within plus or minus 0.003 inch, and a tolerance of plus or minus 0.007 inch is maintained on outside diameter dimensions. Face width dimensions are held to a tolerance of plus or minus 0.003 inch. While work is being performed on this automatic machine, the operator is free to mill the expansion gap required in certain types of rings on an adjacent machine.

Finish boring and turning of these large piston-rings is accomplished in special Fay automatic lathes. A number of rings are stacked together and loaded between two end plates, one of which is mounted at the spindle end of the machine and the other directly opposite the spindle, as shown in Fig. 7. The plate *A* at the spindle end is automatically retracted for loading and unloading, and is advanced for clamping the work. The rings rest on two locating or centering rods, one of which can be seen at *B*. These rods are part of an air-operated cradle that centers the rings on the end plates. The rings are divided into two groups by a centrally located spacer *C*, and are machined by two sets of tools.

The cycle consists of turning the two groups of rings, first with tools *D* on the front slide during the forward stroke, and then with tools *E* on the rear slide during the return stroke. At the same time, both groups are bored by means of four tools, two of which semi-finish the work on the forward stroke of the boring-bar, while the other two finish-bore the rings on the return stroke.

The cycle being completely automatic, a high rate of production is provided. For example, 9-inch diameter rings having face widths of 1/8

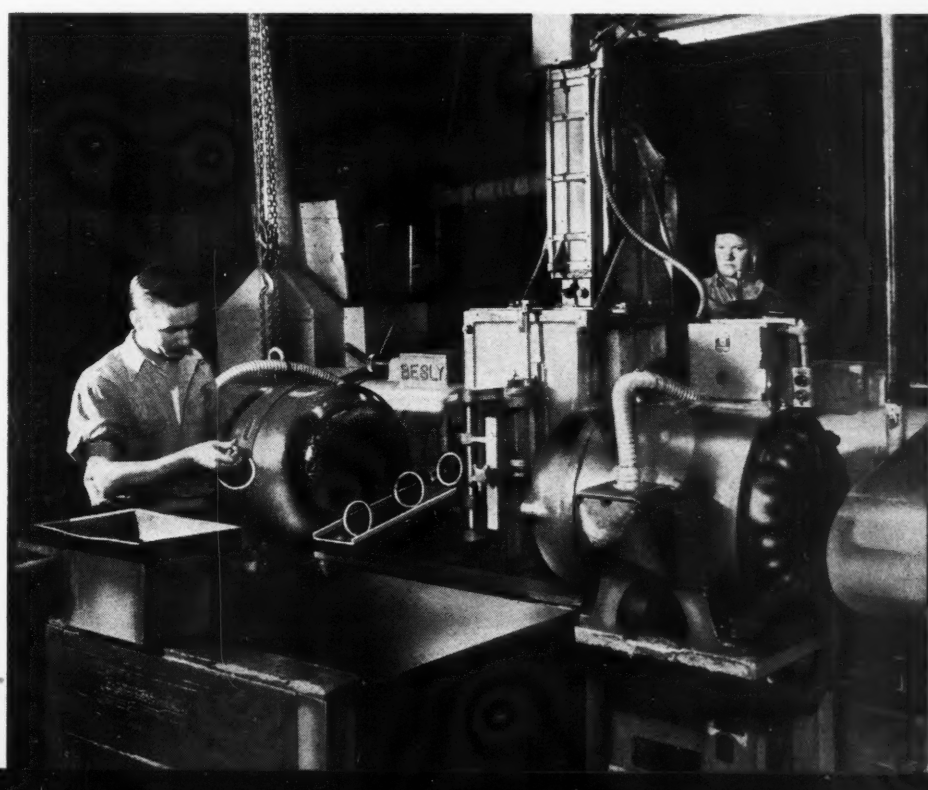


Fig. 8. Sides of piston-rings are ground to within 0.001 inch in special Besly horizontal grinders at the rate of 400 pieces per pass

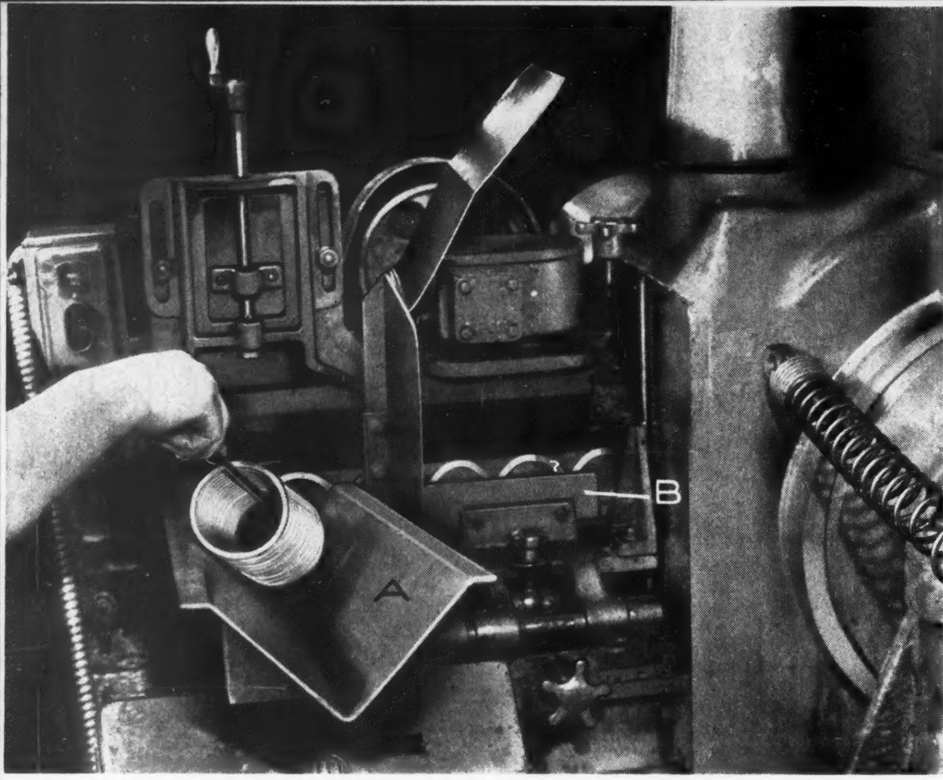


Fig. 9. After the piston-rings have been loaded on inclined ramp (A), a chain with pick-up lugs carries them between two horizontal grinding wheels on a guide rail (B) in grinder shown in Fig. 8

inch can be finish-bored and turned at the rate of approximately 225 per hour. As in all other machining operations in the plant, carbide tools are used for this work.

A special Besly horizontal disk grinder, Fig. 8, is used to grind approximately 0.004 inch of stock from each of the flat sides of the smaller rings after semi-finish-machining. In this operation, the face width is ground to size within plus or minus 0.0005 inch at a production rate of about 400 pieces per pass, depending upon the size of the rings.

As shown in Fig. 9, the rings are loaded into an inclined trough *A*, at the rear of the machine. A chain with pick-up lugs, spaced to suit the diameter of the rings, picks them up individually as they drop into a guide rail *B* at the end of the trough and carries them through the machine between two grinding wheels. Approximately 0.0005 inch of stock is left on each side of the rings for finish-grinding in a special vertical Besly grinder.

This machine is illustrated in Fig. 10, where it can be seen that the rings are stacked vertically, to be picked up in a manner similar to that previously described. As in the other Besly grinder, a pick-up chain carries the rings through a guide rail. In this machine, however, the work passes between two vertically mounted grinding wheels. About 360 pieces per minute, depending upon the size, are finish-ground to within a tolerance of plus or minus 0.00025 inch. An operator at the front of the grinder, Fig. 11, spot-checks the rings for face width as they are ejected.

A clean oil jet in the ejection track sprays over

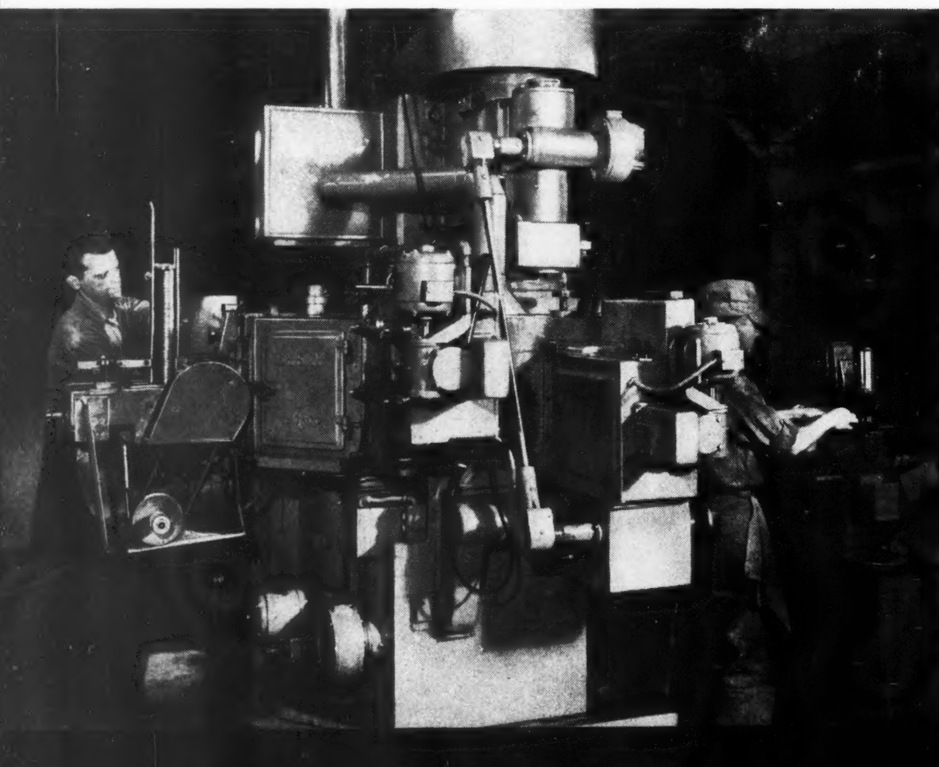


Fig. 10. Finish-grinding faces of piston-rings to within 0.0005 inch is achieved at a high rate of production on this special vertical Besly grinder

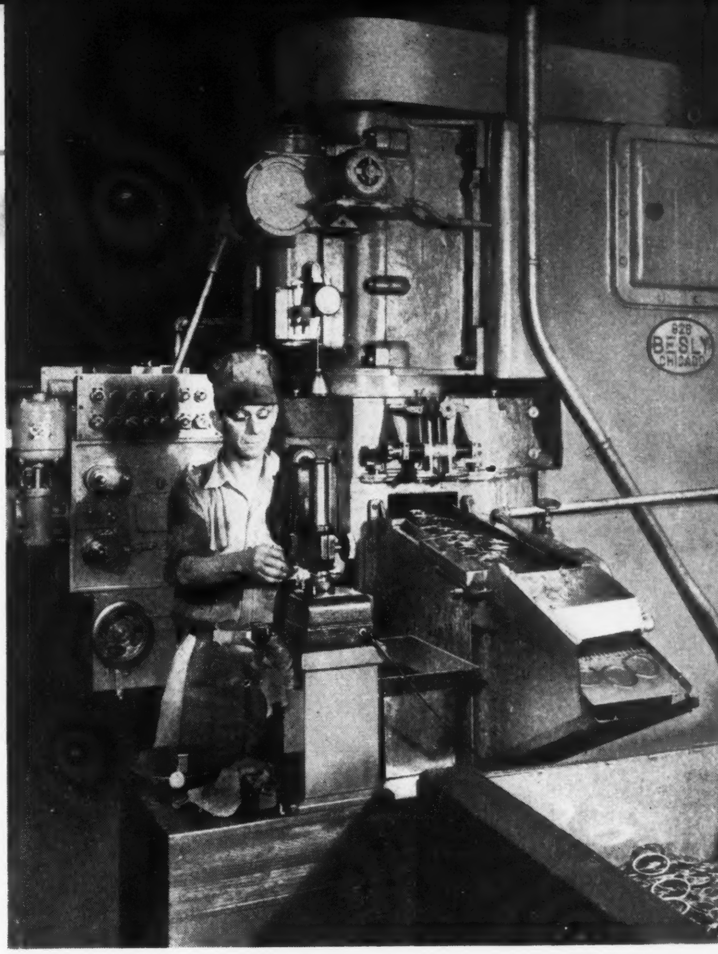


Fig. 11. An operator spot-checks the finish-ground piston-rings for face width dimensions right at the machine

the work, removing oil film and any grit that might have been picked up from the coolant, thus eliminating the necessity for a special cleaning operation.

At this point, compression rings are finish turned and bored in a battery of special Sundstrand hydraulically operated automatic lathes. The operations in these machines are the same for vented oil control rings, except that they are machined to semi-finish dimensions, after which they are processed in a manner that will be described later. Compression rings are finish-turned to within plus or minus 0.0005 inch on the outside diameter dimensions, and the boring operation maintains radial thickness dimensions to within plus or minus 0.002 inch.

In these machines, as in the Fay automatic lathes previously described, a number of rings, say sixty, having face widths of 1/8 inch, are loaded into the lathes between end plates. The sequence of operations is the same, except that, in these machines, two turning and two boring tools are used for machining the two groups of rings. Using carbide tools at an average cutting speed of 200 surface feet per minute, approximately 1200 rings of 3/32-inch face width are finish turned and bored per hour.

Horizontal milling machines, adjacent to these automatic lathes, are used by the same operators to mill expansion gaps in the compression rings. In this operation, a stack of rings is supported between two faces of an air-operated fixture. One of these faces clamps the stack against the other stationary face, after which the rings are milled by means of a high-speed steel cutter. Gap width sizes are held within a tolerance of 0.010 inch. Some compression rings, known as "groove-back" rings are grooved on the inside diameters in special Sundstrand automatic lathes. Fig. 12 illustrates the gang tool set-up used for this work.

Following these operations, many types of compression rings and all types of vented oil con-

Fig. 12. "Groove-back" compression rings are grooved on the inside diameters by means of gang tool set-ups in special Sundstrand automatic lathes

Fig. 13. All piston-rings are heat-formed to maintain desired tension and shape of gap openings in controlled-atmosphere furnaces

trol rings are given a chemical treatment that produces an oil-absorbent, corrosion-resistant surface. This process consists mainly of washing the rings in an emulsion cleaner heated to approximately 170 degrees F., followed by a rinse, and then placing them in a solution of phosphoric acid which produces a chemical reaction with the metal surfaces of the rings. This results in a fine black, non-metallic, crystalline coating consisting principally of iron and manganese phosphate. The affinity of this coating for oil increases the lubricating properties of the rings and reduces wear in operation.

After this surface treatment, the rings are heat-formed to the proper free opening and shape by means of a stress relieving operation in Hayes electric furnaces, employing an oxidizing atmosphere in a 2 1/2 to 1 air-gas ratio. This heat-forming process does not affect the coating produced on those rings that were treated by the process previously described. The tension required in the rings to hold the proper free gap opening is calculated before setting them by heat-forming. After degreasing and cleaning, they are loaded onto fixtures that maintain their circular form and the proper gap openings while they are being treated in the furnaces.

Some of these fixtures are seen in Fig. 13 on a roller conveyor that leads to one of the furnaces. The rings were loaded onto these fixtures by means of a small press after having their gaps aligned. A fixture for spreading the gaps is then employed, after which a blade is inserted in the gaps to hold them open.

Dial indicators are used to insure a roundness of form within 0.003 total indicator reading. A six-hour cycle is required in the furnaces, one hour being spent in the hot zone at 1120 degrees F., and the rest of the time being divided between the preheating and cooling.

After heat-forming, the rings are inspected for tension and for uniformity of shape by means of special gages set up in the same line as the furnaces. Compression rings that have received surface treatment before heat-forming are then dipped in a protective coating of lanolin and wax, after which they are packaged for stock or shipment.

Compression rings that have not been given the surface treatment are subsequently chromium-plated. After being inspected, these rings are loaded in stacks of about 100 on arbors on which they are turned between centers to obtain a smooth surface for plating. In loading the rings on air-operated fixtures for this operation, they are closed to the correct compressed gap. These stacks remain on the arbors during the plating operation.

Prior to plating, however, the expansion gaps (which are not aligned) are plugged by means of small lead wedges that are hammered lightly into place to eliminate gas holes in plating. By maintaining continuous contact in this manner, a uniform plate is assured around each ring and up to the end of its gap. Also, before plating, the rings are honed to a finish of 20 micro-inches r.m.s., or less, to remove all tool marks and surface defects, thereby producing a smooth plating surface, which promotes a good bond between the ring and the chromium plate.

The exposed parts of the arbors are then masked off, and assembled on bus bars and placed in cylindrical anodes. Centering the arbor in the anode is very important. Porcelain spacers and pins are used to insure accurate alignment and to keep the arbors parallel to the anode walls. A space of 1 to 2 inches is maintained between the arbor and the inside wall of the anode.

The plating cycle starts by first using a reversed polarity current to cause a slight etching action. This produces a clean surface on the rings that facilitates cohesion of the chromium and also helps to overcome passivity. In the same set-up, the polarity of the current is changed to plate the rings at a rate of approximately 0.001 inch per hour to a total thickness of 0.004 to 0.006 inch on a side. After the required thickness of plating has been obtained, the current is again reversed and the plated surface is etched to obtain a porous condition. This porosity is full and uniform and extends into the plating to a depth of 0.001 inch, plus or minus 0.0005 inch.

In use, rings of this type are quickly seated in the cylinder walls, as the porous surface wears rapidly. The chromium surface exposed after this "break in" period is hard and extremely wear-resistant, providing a long life for the piston-rings. Final operations on these plated compression rings include grinding the gaps by means of a wheel having a thickness equal to the exact opening required, lapping the sides, and rounding off any sharp edges that may have been produced by plating.

As vented oil control piston-rings are not chromium-plated, they require somewhat different machining operations than those performed on the compression rings. After grinding and being semi-finish-machined in the same machines in which the compression rings are finish turned and bored, oil control rings are beveled, channeled, and finish-turned in Sundstrand automatic lathes.

Following these operations, the oil control rings are milled to provide vents around the outside periphery. Approximately eight equally spaced slots are milled in most small rings, around the periphery, leaving about 30 per cent of the inside circumference as land between the vents. The air-operated fully automatic fixtures used for this work are among the most interesting in the plant. They are used on Cincinnati horizontal milling machines as shown in Fig. 14.

A set-up table (not shown) is employed for centering and loading the rings on arbors. The loaded arbors containing ten or eleven rings, depending on the face width, are placed in a spindle in the fixture. This spindle, which runs in oil on Timken bearings, is automatically indexed for each cut. The index-plates are easily replaced by others when different numbers of vents are to be cut in the rings. A gang of high-speed steel cutters, assembled on an arbor within a non-accumulative spacing tolerance of plus or minus 0.001 inch, is used for slotting the rings.

In operation, there are two special dogs on the machine table, one of which, on the return stroke, trips a micro-switch actuating a solenoid-operated air valve that cocks the operating mechanism of the index-head. Toward the end of the cocking stroke an index-pin is raised out of engagement with the plate by a roller that contacts a cam mounted behind the index-plate. To prevent motion of the spindle when the index-pin is raised, an auxiliary dog remains engaged in the ratchet mechanism.

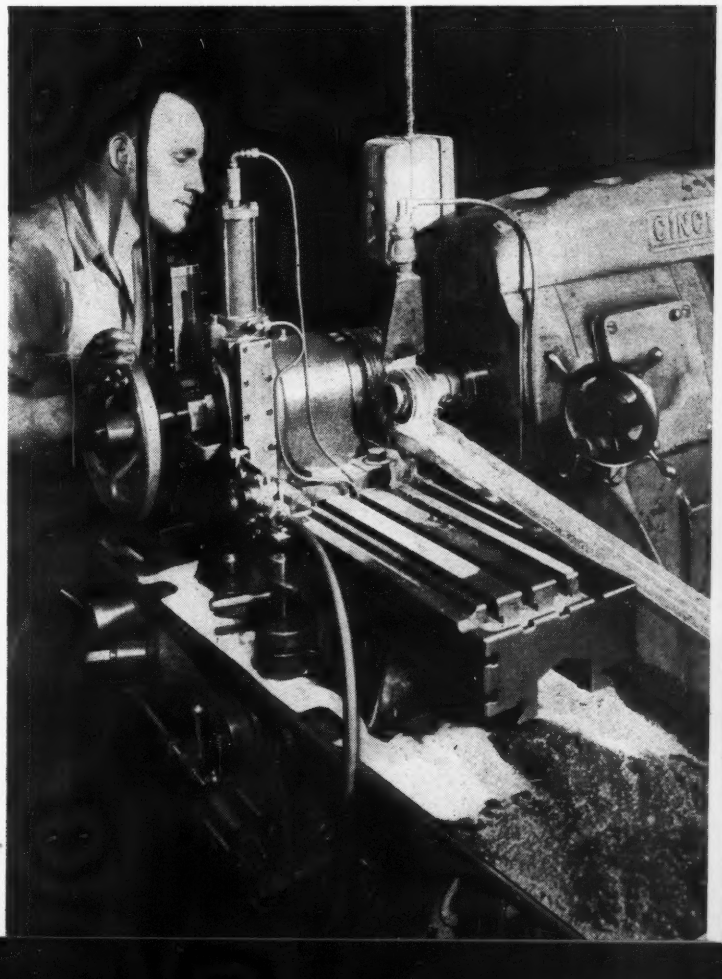


Fig. 14. Vents are automatically milled in the outer periphery of oil control rings, using air-operated fixtures

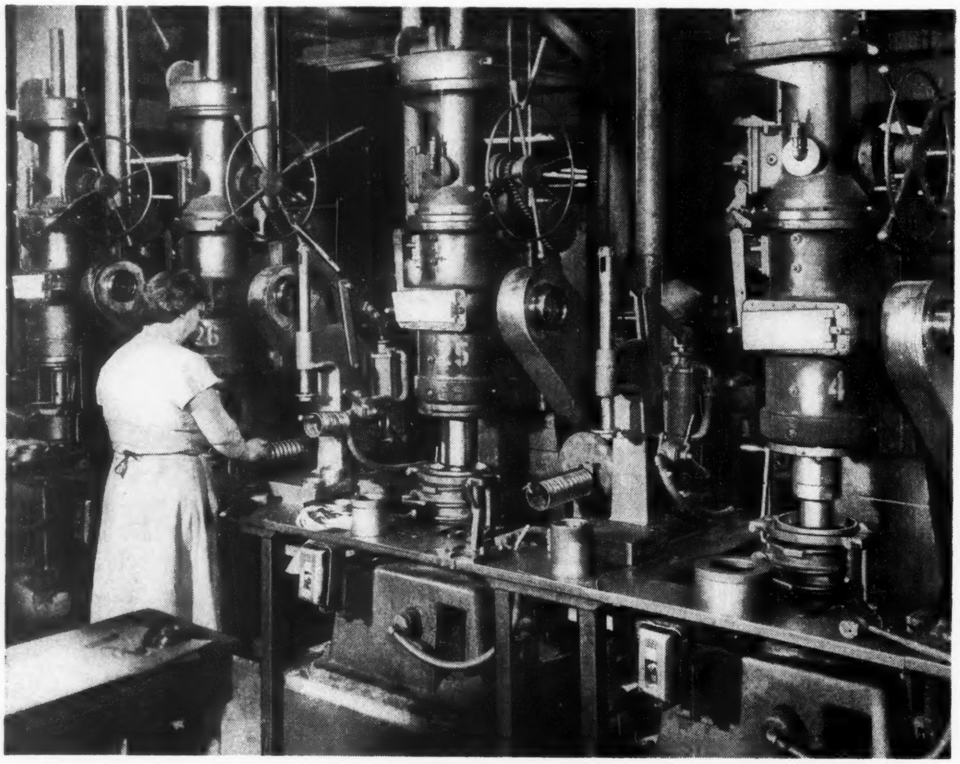
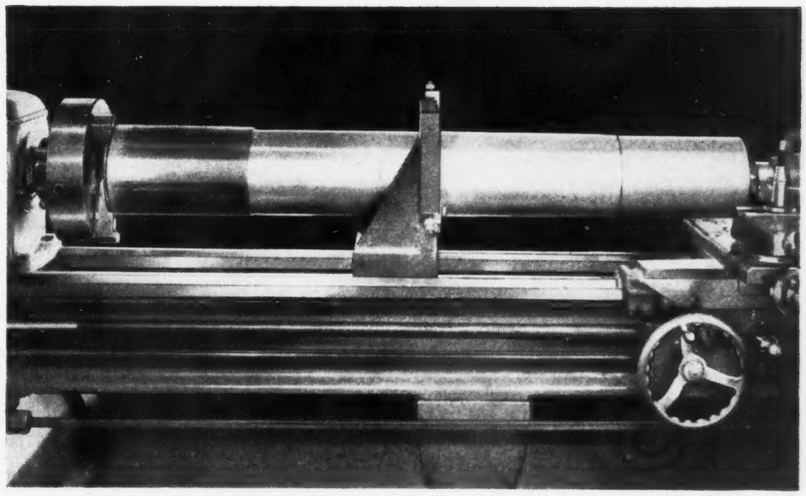


Fig. 15. Boring mills especially designed for finish-boring oil control rings. One operator attends four machines in which the work is held by air-operated fixtures

As the machine table approaches the end of its return stroke, the second dog trips another micro-switch, reversing the solenoid-operated air valve and indexing the spindle. At the start of this motion, the cam, moving away from the roller, allows the spring-actuated index-pin to ride on the periphery of the index-plate until it drops into the next notch. To prevent chatter, air pressure remains on the mechanism while the cutters are in operation. This preloads the mechanism in the same direction as the force applied by the slotting cutters. When the machine, through its automatic table cycle, has indexed the head and milled slots through 360 degrees of rotation, a button on the index-plate trips an air valve which actuates a cylinder to stop the machine in the unloading position with the index-head locked. This mechanism is rigid and permits a quick change of set-ups for varying diameters and face widths. A high rate of production is achieved with these fixtures.

After this operation, expansion gaps are milled in these rings in the same manner as described for the compression rings. This is followed by finish-boring in a battery of machines especially built for this purpose by the Koppers Co. Some of these machines may be seen in Fig. 15. One operator attends four machines, each of which is equipped with two fixtures. While one fixture is in use, the other is being loaded or unloaded. In this operation, 0.010 to 0.015 inch of stock is removed from a side within a tolerance of plus or minus 0.003 inch. Here, again, a high rate of production is achieved.

Making a Half-Ton Spline Broach



WHAT is believed to be the largest broach ever made was recently designed and built by the Detroit Broach Co. to produce the forty-four-tooth involute spline in ring gears for truck rear axles. Nicknamed "Big Boy," the broach is 84 3/4 inches long, 9 3/16 inches in diameter, and weighs more than 1100 pounds. It is employed on a 50-ton horizontal broaching machine, and removes 2 1/4 pounds of metal from the gear on each 72-inch stroke.

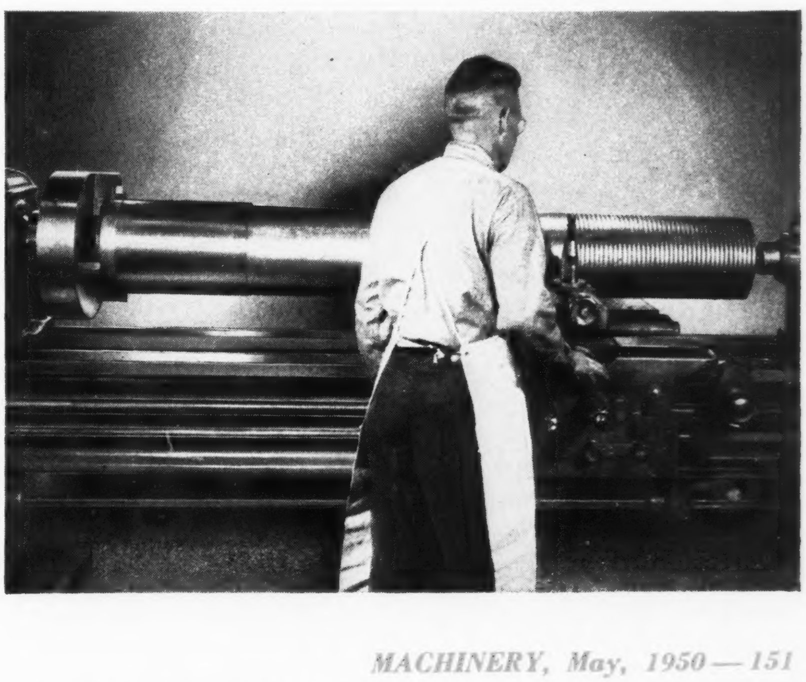
By the use of this broaching equipment, machining time has been reduced 98.4 per cent—from 44 minutes 48 seconds to 42 seconds. Handling has also been decreased, since two operations were required previously, while with the present broaching method, the teeth are completed in one operation. Expenditures for new tools have been reduced by one-third, and the cost of tool sharpening is only one-twelfth what it was when other methods were employed.

The broach is of sectional design, being made in four separate pieces—a front shank, a shell type front pilot, a cutting section, and a rear shank. This design facilitates manufacture and decreases tool costs, since only the cutting section need be replaced when the tool becomes worn. The cutting section of the broach was produced from a 4000-pound ingot of 18-4-1 high-speed steel, cast by the Universal Cyclops Steel Corporation from a carefully controlled melt in an electric-arc furnace. Immediately after casting, the ingot was transferred to a pit type annealing furnace in order to develop a uniform grain structure in the steel.

After cooling in the annealing furnace, the ingot was heated to approximately 2150 degrees F. in another furnace for the first breakdown operation on a 12,000-pound steam hammer. Several reheatings and breakdown operations were required to forge the ingot into a suitable size for subsequent swaging. After a controlled cool-

Fig. 1. (Above) Turning the forged cutting section of the broach. The forging is previously drilled and bored to reduce its weight and improve hardenability

Fig. 2. (Right) Cutting section of the broach being grooved to provide 136 teeth having a pitch of 1/2 inch. The grooved section is ready for hardening



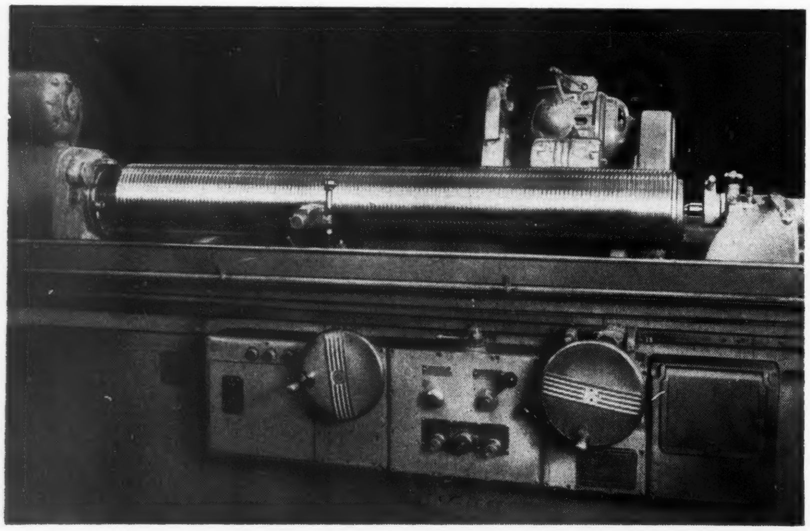


Fig. 3. After heat-treatment, the lands and relief angles of the teeth are ground on a cylindrical grinding machine

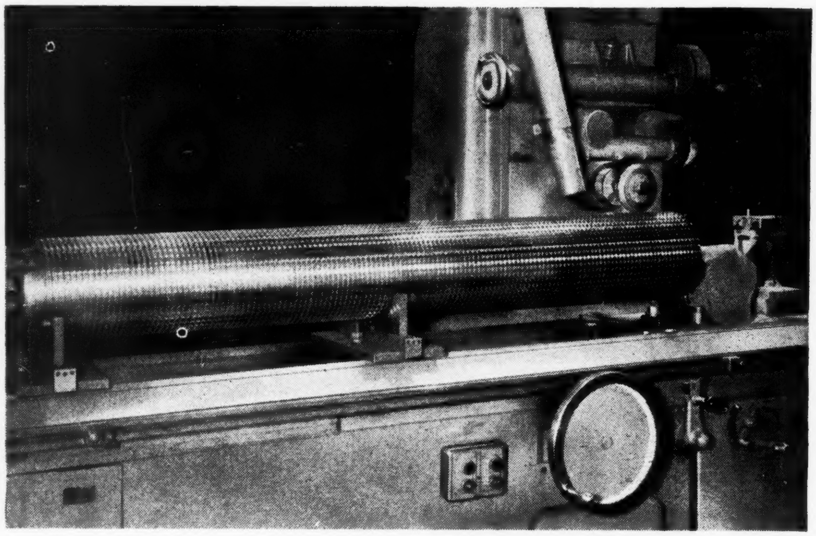


Fig. 4. Spaces between adjacent rows of teeth on the broach are then finish-ground on a surface grinder especially adapted for the operation

ing cycle, annealing, and reheating, the billet was swaged in round dies. The swaged forging was then annealed once more, after which it was rough-turned and sawed to obtain a bar 9 1/2 inches in diameter by 69 1/2 inches long, weighing 1571 pounds.

After being delivered to the Detroit Broach Co., the cutting section was drilled and bored to produce a tubular member having a wall thickness of about 2 1/4 inches. Boring, of course, reduced the weight of the section and minimized handling problems during its manufacture and use. The hollow construction also allowed a more uniform heat-treatment of the machined section. Stock was turned from the periphery of the forging on the Monarch lathe seen in Fig. 1. The grooves or tooth forms were then rough-machined, as shown in Fig. 2, to provide 136 teeth with a pitch of 1/2 inch. Threads were cut in the bore, at each end of the part, for subsequent assembly of both the front and the rear shanks.

Prior to hardening, the cutting section of the broach was stress-relieved by heating to 1200 degrees F. in a vertical, atmosphere-controlled furnace. After removal from the stress-relieving furnace, the part was air-cooled to room temperature. Hardening was then accomplished by raising the temperature of the work progressively to 2350 degrees F. in three separate furnaces, and quenching in oil.

Preliminary heating in the first furnace raised the temperature of the part to 1100 degrees F. In the second furnace, the temperature was increased to 1600 degrees F., after which the part was transferred to the high-heat furnace. Rapid transfer of the work from furnace to furnace was accomplished by means of a variable-speed

hoist. A specially constructed rotating fixture was employed in each furnace to revolve the work at 8 R.P.M., thus insuring thorough and uniform heating.

The cutting section of the broach was removed from the agitated quenching oil when its temperature reached 800 degrees F., and allowed to air-cool to room temperature. Run-out over the entire length of the broach was only 0.032 inch, and subsequent straightening was not necessary. A hardness of from 64 1/2 to 65 Rockwell C was obtained with this heat-treatment, by the Commercial Steel Treating Corporation, Detroit, Mich.

After heat-treatment, the cutting faces of the teeth and the chip pockets were ground. The periphery of the broach (which forms the straight lands on the cutting teeth) and the back-off angles of the lands were ground on the Cincinnati cylindrical grinding machine in Fig. 3. The roughing teeth on the broach were ground with a taper or step of 0.005 inch per tooth (on their diameter). Semi-finishing teeth were provided with less taper, and a few finishing teeth were ground to the same diameter, with no taper.

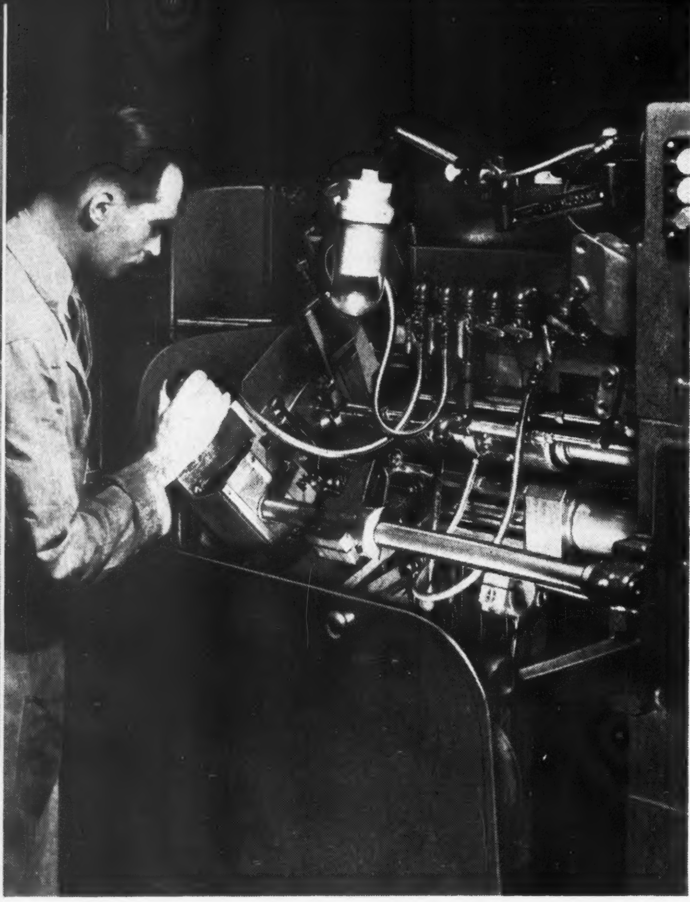
The full length and depth of the involute form between adjacent rows of teeth was ground on the Thompson surface grinding machine seen in Fig. 4, which was specially adapted for this operation. Only a short stroke of the work-carrying table was necessary during initial passes, but as the form between adjacent rows of teeth became deeper, the traverse of the table past the grinding wheel was progressively lengthened. When the involute form had reached the required depth and size, several passes were made with no down feed, thus permitting the grinding wheel to "spark out." The broach was then indexed the proper amount, and the next space was ground.

Chip-breakers were next ground in the lands, and the cutting faces of the teeth were sharpened and polished. The involute form, chordal tooth thickness, tooth spacing, diameters of pilots and cutting section, and all other dimensions were carefully checked before shipment to the user—the Eaton Mfg. Co., Axle Division, Cleveland, Ohio.

* * *

Evening courses leading to a bachelor of science degree in mechanical, electrical, civil, and chemical engineering, architecture, and industrial administration have been announced by the Drexel Institute of Technology, Philadelphia, Pa. Prior to this the bachelor and master of science degrees have been offered only in day courses at the institute. The new evening courses will not replace the former courses.

The life expectancy of this pickling tank, which handles 3 to 5 per cent sulphuric acid at 160 to 170 degrees F., is twenty-five years. It is made of Carpenter No. 20 stainless steel. Tanks constructed from materials other than this corrosion-resistant alloy lasted only about four years, and required excessive maintenance



Automatic or

How to Get the Answer as to which Type of Lathe Best Suits Your Requirements

FOR some years the general trend in machine tool design has been increasingly toward automatic operation. The three main underlying reasons have been: (1) The economies thereby made possible through reduction in direct labor cost; (2) easier control over the rate of production; and (3) easier control over accuracy when only inexperienced operators are available.

During the war, this trend was accentuated by the production urgency, by the abnormally large lots of repetitive work-pieces, and by the lack of enough skilled operators to meet the emergency. Speed of production rather than cost was a primary factor. Out of this situation there developed the general impression that an automatic machine is better than, or at least an improvement upon, a hand-operated machine. But both types of machines are good; the question is, which one is more profitable for the job in hand?

There are obviously some types of work that, because of unusual job characteristics, definitely belong on hand-operated machines. It is not the intention to consider that kind of work in this article, but rather the kind of work that, from an operating standpoint, may be done on either machine, thus placing the basis for machine selection squarely on the question of how much it costs to produce the work.

Today accuracy is no longer an important consideration in making a choice between automatic and hand-operated machines because the shortage of capable operators experienced during the war is over. Conversely, refinements in automatic design now permit work to be produced that is of a quality formerly obtained only by experienced control of hand-operated machines.

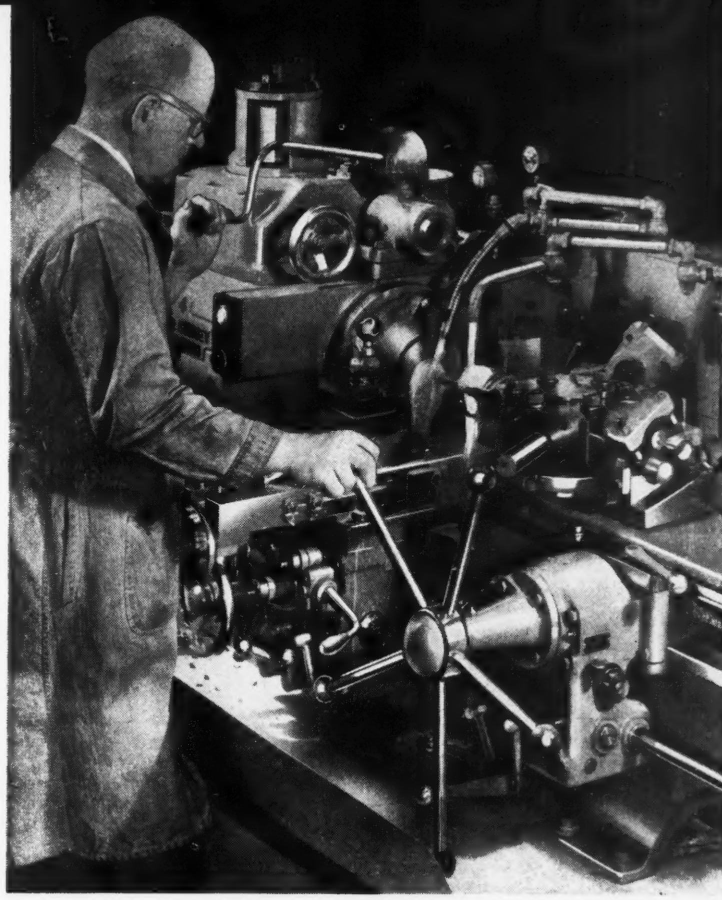
There is a sustained post-war interest in the advantages of automaticity for controlling the rate of production. This advantage, however, is fictitious unless the over-all cost of producing work at controlled rates is at least equal to, or less than, the cost of the same work done on manually controlled machines. The fact is that today a choice between an automatic and a hand-operated lathe of either the engine or turret type, for work that can be properly done on either machine, narrows down to cost factors.

The first of these factors is, of course, the relatively higher cost of an automatic, which is from three to four times that of a hand-operated lathe. This necessitates the inclusion of depreciation in the comparative calculations. Labor costs are naturally one of the main considerations. A common error is that of putting too much emphasis on the factor of direct labor costs without sufficient regard to the other items of labor cost involved. Set-up time, for example, is longer on an automatic than on a hand-operated machine. However, once the machine is set up, it can be operated by a tender instead of a more skilled operator. And where you have a bank of machines, a set-up man and a machine tender can handle several machines, if the work is properly arranged.

There may be added special factors. For instance, special tooling, the cost of which must usually be recovered within the life of the tools or the duration of the job run, may be required for an automatic, whereas the same job could be done with standard tools on a hand-operated machine. On the other hand, automatics, turning out larger volume in less space, might in some cases make a plant expansion unnecessary. Factory overhead (excluding depreciation) will probably be about equal for both types of machines, and so, for purposes of comparative costs, can be left out of consideration.

Hand-Operated?

By DONALD M. PATTISON
Vice-President in Charge of Sales
The Warner & Swasey Co., Cleveland, Ohio



At the Warner & Swasey Co., where both automatics and hand-operated turret lathes are built, it is believed that basic arithmetic can provide the answer to "automatic or hand operation." One of the best ways to help a customer decide whether he should buy an automatic or a hand-operated turret lathe is to help him determine the number of pieces for a given job that will represent the same cost whether run on an automatic or on a hand-operated machine.

If fewer pieces are required than this quantity, the job should be put on a hand-operated machine. If more pieces are required than represented by the "break-even" lot size, an automatic is usually the answer.

How can this "break-even" point be determined? It can be quickly determined by substituting known or estimated values in a formula which relates all of the important elements that make up production cost, as follows:

$$Q = \frac{pP\ (SL + SD - sl - sd)}{P\ (l + d) - p\ (L + D)}$$

where

Q = quantity of pieces at "break-even" point;
p = number of pieces produced per hour by the turret lathe;
P = number of pieces produced per hour by the automatic;
S = set-up hours required on an automatic;
s = set-up hours required on a turret lathe;
L = labor rate for automatic, in dollars;
l = labor rate for turret lathe, in dollars;
D = hourly depreciation rate for automatic (based on machine-hours for a ten-year period); and
d = hourly depreciation rate for turret lathe (based on machine-hours for a ten-year period).

Assume that it is desired to find value Q when the various factors are as follows: $p = 10$ pieces per hour; $P = 30$ pieces per hour; $S = 6$ hours; $s = 2$ hours; $L = \$1.50$ per hour; $l = \$1.50$ per hour; $D = \$1.175$ per machine hour; and $d = \$0.40$ per machine hour.

Then, substituting these values in the formula:

$$Q = \frac{10 \times 30\ (6 \times 1.5 + 6 \times 1.175 - 2 \times 1.5 - 2 \times 0.4)}{30\ (1.5 + 0.4) - 10\ (1.5 + 1.175)}$$

Answer: $Q = 121$ pieces, or the quantity of parts on which the cost is the same for either machine.

The general formula is a bit complicated for rule-of-thumb use, and may be simplified for exploratory applications without serious loss in accuracy.

If, for example, it is assumed:

1. That the labor rate for set-up and operating is \$1.50 per hour and is the same for both types of machines; (With either machine it is often the case that the same man who sets up the machine also operates it.)

2. That automatic set-ups average only three times the length of hand-operated turret lathe set-ups, and that automatic hourly production averages three times greater than turret lathe production (Warner & Swasey experience);

3. That factory overhead, except for machine depreciation, is about the same for each type machine and hence can be left out of the calculations; then the "break-even" formula can be rewritten as follows:

$$Q = 6sp$$

This is a workable formula for rule-of-thumb use which sums up the factors that influence the balance or "break-even" point in production lot

sizes for the turret lathe and automatic. Such a simple formula can be of great preliminary help to the tool engineer who must frequently decide which machine to tool up for a certain job. Suppose, for instance, he has a new job to handle which has not yet been produced in his shop. Should it be tooled up on a turret lathe or on an automatic? Either by using shop averages or by actual job estimating, he can quickly determine that this job could be set up in, say, 2.5 hours on a turret lathe which would produce at the probable rate of 15 pieces per hour.

Then, substituting these figures in the formula $Q = 6sp$, it is determined that

$$Q = 6 \times 2.5 \times 15 = 225 \text{ pieces}$$

This information provides the clue to the general range of lot sizes at which point the automatic and turret lathe compete, cost-wise. However, it must be borne in mind that this "break-even" point of 225 is based on a set-up ratio of 1 to 3 which exists between a turret lathe and a cam-less automatic. If the same job were produced on a cam type automatic, which may require eight times as much set-up time as the turret lathe, the latter could produce as efficiently as that type of automatic until the quantity reached at least 900 to 1000 pieces per lot.

A production or methods department could use the formula $Q = 6sp$ to route work to the turret lathe or automatic in cases where the use of standard tooling makes it unlikely that the tool designer would have a hand in the job. For instance, suppose that a standard part has been running at various times on either an automatic or a turret lathe, the choice of which was loosely controlled by fear of the unknown "break-even" point, limiting the use of the automatic to only the longest job runs on that particular part. Application of the formula would permit a closer relation to be established between lot size and machine type, thus utilizing to a greater extent the inherent ability of a multiple-spindle machine to produce work at faster rates and at lower cost.

Another use of "break-even" point arithmetic is in helping to solve management's problem of which machine to buy. Machine tool assets are important investments and must be closely keyed to the kind and quantity of work produced in order to operate at a consistently high level of efficiency. This efficiency cannot be secured unless machine types are compatible with lot sizes; and it is here that "break-even" point arithmetic offers its greatest return.

The general formula mentioned first in this article provides for all of the variables, such as set-up and production ratios, labor and depreciation rates, etc. Hence, this formula is best suited to determining the "break-even" point where accuracy is a prime requisite; or, where known factors are widely divergent from the assump-

Derivation of General Formula

$$s(l+d) + \frac{Q}{p}(l+d) = S(L+D) + \frac{Q}{P}(L+D)$$

$$sl + sd + \frac{Ql}{p} + \frac{Qd}{p} = SL + SD + \frac{QL}{P} + \frac{QD}{P}$$

$$\frac{Ql}{p} + \frac{Qd}{p} - \frac{QL}{P} - \frac{QD}{P} = SL + SD - sl - sd$$

$$QlP + QdP - QLp - QDp = pP(SL + SD - sl - sd)$$

$$Q(lP + dP - Lp - Dp) = pP(SL + SD - sl - sd)$$

$$Q = \frac{pP(SL + SD - sl - sd)}{P(l+d) - p(L+D)}$$

Note: $s(l+d)$ = cost of turret lathe set-up;

$\frac{Q}{p}(l+d)$ = cost of turret lathe production of Q_1 parts;

$S(L+D)$ = cost of automatic set-up; and

$\frac{Q}{P}(L+D)$ = cost of automatic production of Q_2 parts.

If $Q_1 = Q_2 = Q$ (when total cost of producing same quantity of parts is same on both the turret lathe and automatic), then first line in above derivation holds true.

Derivation of Formula Q = 6sp from the General Formula

$$Q = \frac{pP(SL + SD - sl - sd)}{P(l+d) - p(L+D)}$$

where $P = 3p$; $S = 3s$; $L = \$1.50$; $l = \$1.50$; $D = \$1.175$ (average hourly depreciation rate for W & S automatics); and $d = \$0.40$ (average hourly depreciation rate for W & S turret lathes of comparable capacity to automatics).

$$Q = \frac{p \times 3p\,(3s \times 1.5 + 3s \times 1.175 - s \times 1.5 - s \times 0.4)}{3p\,(1.5 + 0.4) - p\,(1.5 + 1.175)}$$

$$= \frac{3p^2\,(4.5s + 3.525s - 1.5s - 0.4s)}{5.7p - 2.675p}$$

$$= \frac{3p^2 \times 6.125s}{3.025p}$$

$$Q = 6sp$$

tions prerequisite to the use of the rule-of-thumb formula $Q = 6sp$.

Many other circumstances support the use of the rule-of-thumb formula where only an approximation of lot size quantities is needed as a basis for further inquiry into the matter of work cost. At such times, the general assumption of the 3 to 1 ratio for cam-less automatics to hand turret lathes is entirely justified for average shop conditions.

For example, the Rotor Tool Co., Cleveland, Ohio, is a shop which finds it profitable to schedule small-lot work to its cam-less automatic. To what extent would some form of "break-even" point arithmetic have guided the company in a preliminary consideration of the purchase of this machine, and subsequently in selecting economical lot sizes?

Assume as a first step that the Rotor Tool Co. selected the five representative turret-lathe jobs listed in the accompanying table and subjected them to a "break-even" point analysis by the use of the formula $Q = 6sp$, which assumes a 3 to 1 ratio for set-up and production between a turret lathe and a cam-less automatic. Suppose, next, that the economy of the "break-even" point lot sizes as indicated by the figures in column 5 of the table supported a decision to install an automatic.

After the automatic was installed, five typical jobs were set up and run on the machine and the true ratios between the automatic set-up and production and turret lathe performance were established. These true ratios for the five sample jobs are listed in the third and fourth columns. With this data at hand, it was possible to substitute the true ratios in the longer general formula, so that a more accurate picture of "break-even" point lot sizes could be obtained. These figures are listed in the second column.

Analysis of Five Jobs in the Shop of the Rotor Tool Co.

Job No.	True "Break-Even" Point, Number of Pieces	Set-up Ratio Turret Lathe to Automatic	Production Ratio Turret Lathe to Automatic	Calculated "Break-Even" Point Using Formula $Q = 6sp$	Corrected "Break-Even" Point Using Formula $Q = 3.7sp$
1	112	1 to 1.6	1 to 2.9	285	176
2	101	1 to 2.5	1 to 4.1	156	97
3	244	1 to 2.5	1 to 2.5	250	152
4	59	1 to 2.3	1 to 4	105	65
5	88	1 to 2.9	1 to 6	130	82

It is to be noted that the true "break-even" point and that calculated by using the formula $Q = 6sp$ differ considerably, depending on the variation of the true ratios from the assumed ratios. This is natural, but the variation for any such job comparison is almost always in favor of the true lot size "break-even" point—or, expressed differently, in favor of the automatic. It is the ratio in any "break-even" point formula that has the greatest influence of any factor on its ultimate accuracy, and in the case of $Q = 6sp$, the assumed 3 to 1 ratio is conservative.

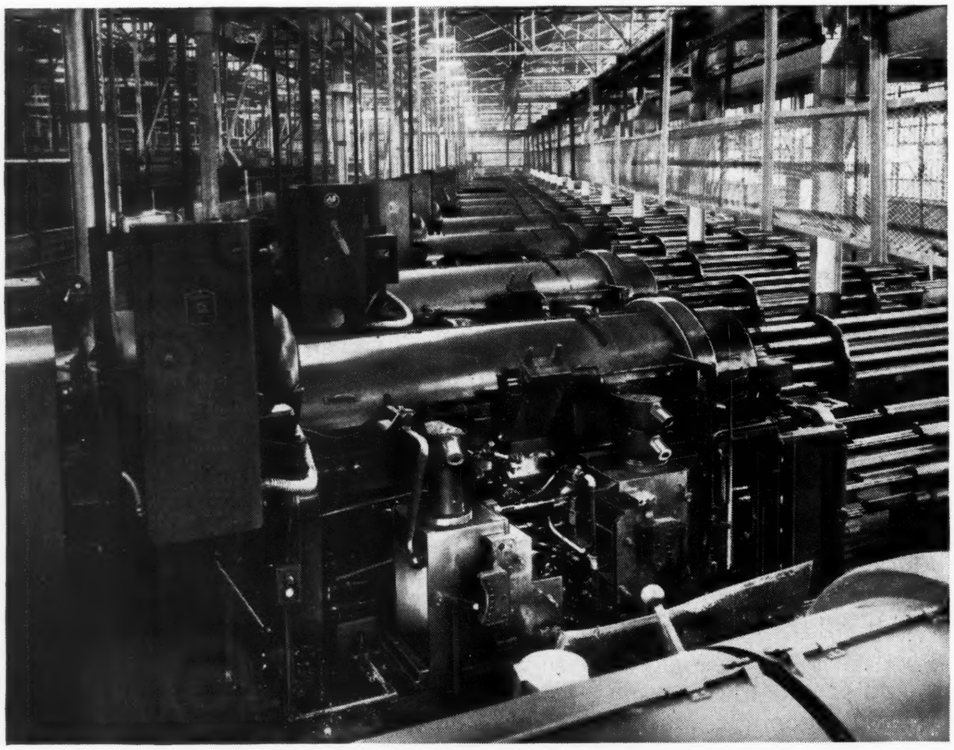
One more benefit can be obtained from established data. For example, suppose that the Rotor Tool Co. still desired a rule-of-thumb formula based on the ratios applying specifically to the conditions under which their turret lathes and automatics operate in daily practice. If the examples given in the table are considered typical, the average ratios may be figured for both set-up and production and substituted in the general formula for Q. Then, if 1 to 2.36 is the average ratio between turret lathe and automatic set-up time, and 1 to 3.9 is the average ratio between turret lathe and automatic production, $Q = 3.7sp$, provided all other factors are given the same value as when the formula $Q = 6sp$ was developed.

To realize the greater accuracy of the specific formula $Q = 3.7sp$ over the simple formula $Q = 6sp$, refer to the last column of the table. These "break-even" point figures have been calculated by substituting the actual turret lathe set-up and production times for the five jobs in the new simple formula $Q = 3.7sp$. Notice how closely the values of this rule-of-thumb formula approach the true "break-even" points, even though the average ratios were established from only a small sampling of many jobs.

Over an interval of time, production records will furnish a broad index of comparative set-up and production times which can thus represent a better average of shop practice. In that case, the simple formula for Q may be further refined to extend its accuracy for all jobs.

The all-important point for both the seller and the user of automatic and hand-operated machine tools is to determine the "break-even" point for the work to be done. Each machine has a definite place in our production economy. Which one should be used for a particular job depends upon which can do the job at the lowest cost.

Making Ford Transmission Main



MULTIPLE-SPINDLE automatic bar machines are used extensively in producing automotive parts from bar stock at the Mound Road plant of the Ford Motor Co., Dearborn, Mich. The heading illustration shows a battery of twenty-eight "Conomatics" employed for machining transmission main-shaft over-drives, retainer wheel bearings, and flanged and plain race universal joint bearings.

Eight Conomatics in this battery are used to machine the transmission main shaft shown in Fig. 1. The application of multiple-spindle automatic bar machines for producing this part is somewhat out of the ordinary because of its length, which is 24 3/16 inches. In order to handle this length conveniently, the part is made on 2 5/8-inch, eight-spindle machines, which permits the long turning operations to be divided among the numerous end-working positions. These machines are equipped with special electrically controlled hydraulic stock feeds, as the standard feeding mechanism cannot be used for the length of feed required for the job. A brief explanation of the principal operating mechanisms in the eight-spindle Conomatic will be given before describing the sequence of machining operations and the tooling used for this job.

An overhead camshaft carries the cams that operate the cross-slides, tool-slide, auxiliary attachments, stock feeding and collet closing mechanisms, etc. The work-spindle drive-shaft passes through the center of the spindle-carrier and drives the eight work-spindles through gearing. An arm, attached directly to the camshaft, engages lugs on the spindle-carrier to rotate it through an arc of 45 degrees for each complete indexing. Six cross-slide positions are provided for forming and cutting-off tools, three at the front and three at the rear of the machine. Stop-buttons for each forward movement of the cross-slides are positioned by the spindle-carrier as it indexes from station to station.

End-working tools are carried by a cylindrical main end-slide which has eight T-slots for locating and clamping the tools. Roller supports for steadying the work against the thrust exerted by forming tools are also carried on this tool-slide. An auxiliary cross-slide, mounted on either or both sides of the top frame member of the machine and operated by cams on drums on the camshaft, provides two cross-slide tool positions for taper-turning, necking, back-facing, cutting off, etc. Additional end-working tools for drilling, reaming, and counterboring are carried by auxiliary attachments which are operated by individual cams on the camshaft.

The eight tooling positions used in producing the transmission main shaft are shown in Fig. 2 arranged consecutively in a vertical position,

Shafts on Automatic Bar Machines

Production of Ford Passenger Car Transmission Main Shafts Exceeding Two Feet in Length is Considerably Facilitated by Utilizing Eight-Spindle Automatic Bar Machines

By GEORGE H. DeGROAT

with the tools at the end of their respective operations. Their positions relative to the work-spindles are indicated in the diagram at the right. The shaft is made from 1 11/16-inch diameter cold-drawn steel (S A E 4024). It is turned, formed, center-drilled, grooved, and cut off at the rate of forty pieces per hour for each machine. A spindle speed of 247 R.P.M. is used, which gives a cutting speed of 109 surface feet per minute.

After the finished shaft is severed from the bar and fed out of the machine in the eighth position, the work-carrier indexes to bring a new bar to the first position where the machining operations start. Here the bar is turned to 1 1/4 inches in diameter with a roller turner at a feed of 0.012 inch per revolution. The length of this cut is approximately one-third the length to be turned prior to the form turning done in the sixth position. The rolls of the turner support the stock and bear upon it at a point ahead of the turning tool. From the tooling lay-out it can be seen that these roller supports are used in all the machining operations.

In the second position, another roller turner finishes the rough-turned length of the bar to 1 3/16 inches in diameter at a feed of 0.012 inch per revolution, while a second roller turner rough-turns an additional length to 1 1/4 inches in diameter. Two sections of the bar are rough-formed in this position, one in preparation for machining the oil-groove section, and the other, preparatory to a finish-forming operation. The feed used for these rough-forming cuts is 0.0013 inch per revolution. The end of the bar is spot-drilled in this position preparatory to center-drilling at the fourth station.

Some of the tools used for these operations may be seen in Fig. 3, where a close-up view of the tool area at the front of an eight-spindle Conomatic is shown. In this illustration, bar *A* is shown after the second-station operations have been completed and it has been indexed to the third station. The extra wide main cross-slide that holds the form tools at the second and third stations may be seen at *A* in Fig. 4.

At the third station, a roll support is used in combination with a carbide-tipped shoe to support the work for two forming operations. One of these forming cuts semi-finishes the section in which the oil-groove is to be machined, and the other is a finishing cut at a feed of 0.0013 inch per revolution.

Adjoining this finish-formed section, a knee turner is used to continue the rough-turning of the bar to 1 1/4 inches in diameter. At the same time, a regular turner, with a feed of 0.011 inch per revolution, continues finish-turning the 1 1/4-inch diameter section to 1 3/16 inches. In this cut, a special single roll support, mounted on the turner frame, is used, together with a roll support on the tool-slide. The end of the bar is chamfered and faced with a combination roll support and facing and chamfering tool.

This end of the shaft is center-drilled at the fourth station, utilizing a three-roll rest for support. The drill is held in a conventional accelerated drill attachment mounted on the main end-slide *B*, Fig. 4. Running at 650 R.P.M. in the opposite direction to the work spindle rotation, the drill speed, in effect, is 897 R.P.M.

A regular turner, with a feed of 0.011 inch per revolution continues finish-turning the 1 1/4-inch diameter section to 1 3/16 inches, using a special single roll support mounted on the turner frame in conjunction with a three-roll support

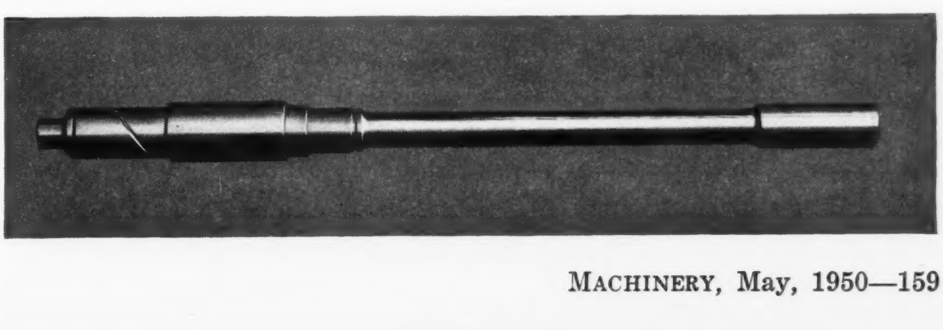


Fig. 1. Transmission main shaft over 2 feet long produced at the rate of forty per hour on automatic bar machines such as shown in the heading illustration

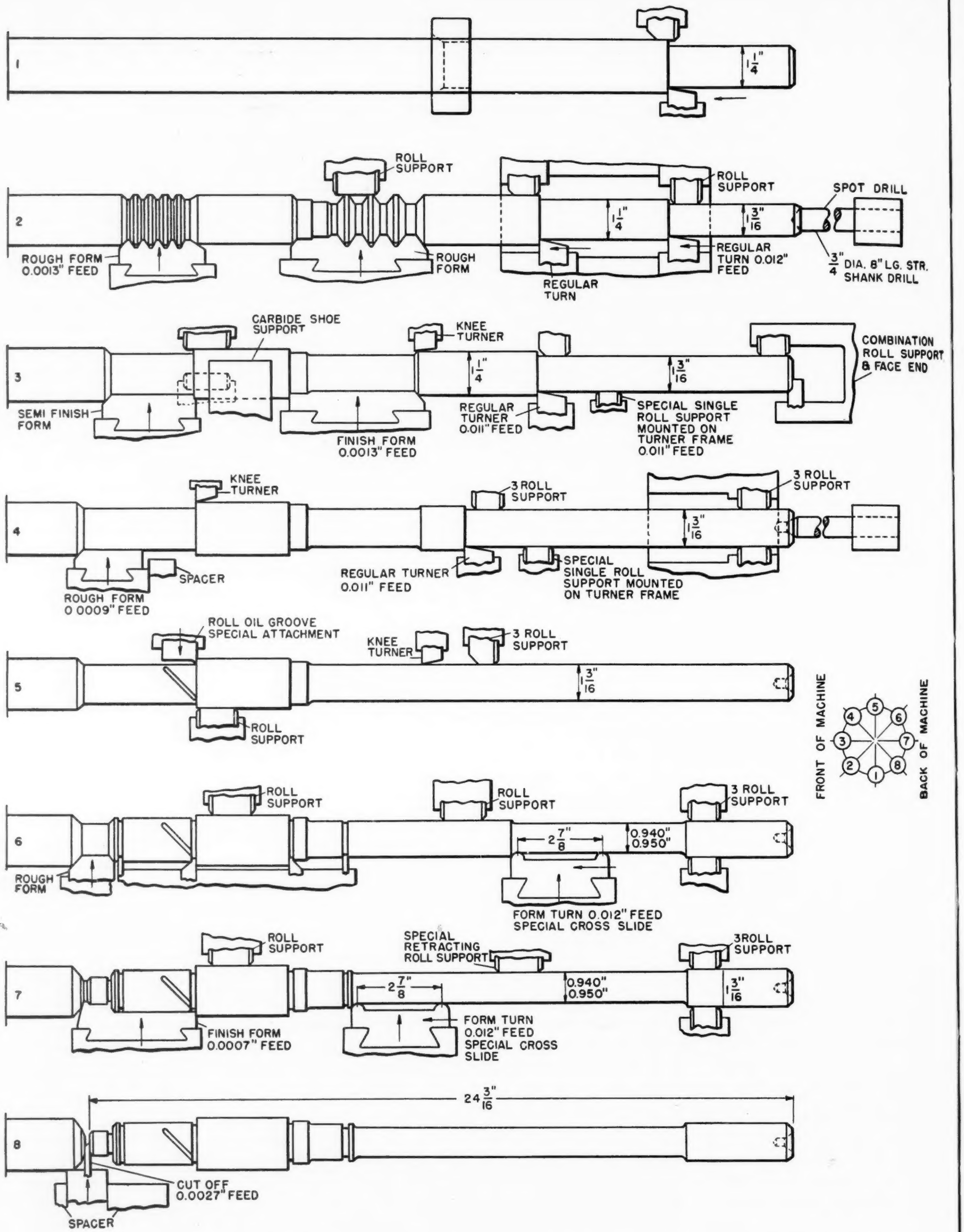


Fig. 2. Tooling lay-out for producing the transmission shaft illustrated in Fig. 1 on eight-spindle Conomatic automatic bar machines

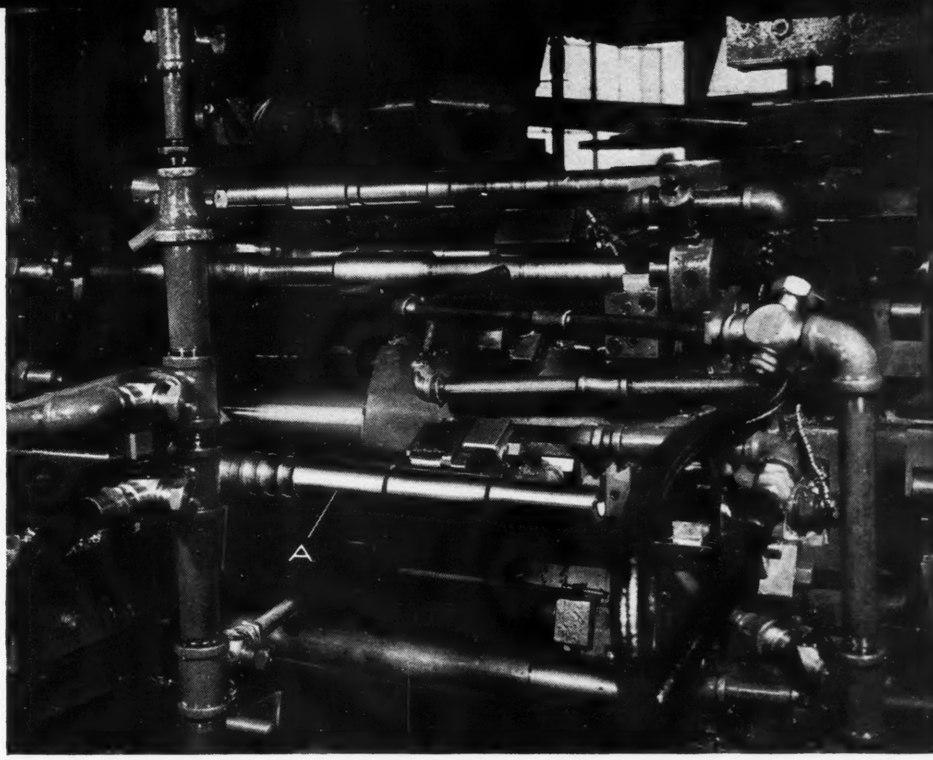


Fig. 3. Close-up view of tooling area at the front of an eight-spindle Conomatic. Bar (A) has been indexed from the second to the third station after the performance of a rough-forming operation

on the main end-slide. Another turning operation is performed by a knee-turner, while a form tool rough-cuts an additional length of the bar at the cut-off end, with a feed of 0.0009 inch per revolution. The cross-slide for the fourth position may be seen at *C* in Fig. 4.

A special attachment, developed by the Cone Automatic Machine Co., is employed in the fifth position to produce the oil-groove. This is accomplished by means of a grooving roll held in the fifth-position cross-slide and driven by a shaft *D*, Fig. 4, having a universal joint which permits the roll to be moved into and out of position with the movement of the slide. At this station, also, the remaining rough-turned diameter is finish-turned to 1 3/16 inches by a knee-turner. Roll supports are used for both of the operations performed at this station.

At the sixth station, a special cross-slide is used to hold a forming and turning tool that reduces a section of the 1 3/16-inch diameter to between 0.940 and 0.950 inch. A three-roll support is employed for this operation. The carbide-tipped tool is fed at a rate of 0.012 inch per revolution.

The cross-slide is supported by a special frame secured to the top bed and base members of the machine at a point approximately in the middle of the tool area. Two dovetailed slides that hold the form turners at this station and also at the seventh station are supported by the special cross-slide, which imparts the radial movement necessary to feed the tools to the required depth. The dovetail slides are moved axially along their ways by the main end-slide to obtain the required length of cut. This accomplishes the under-cut-

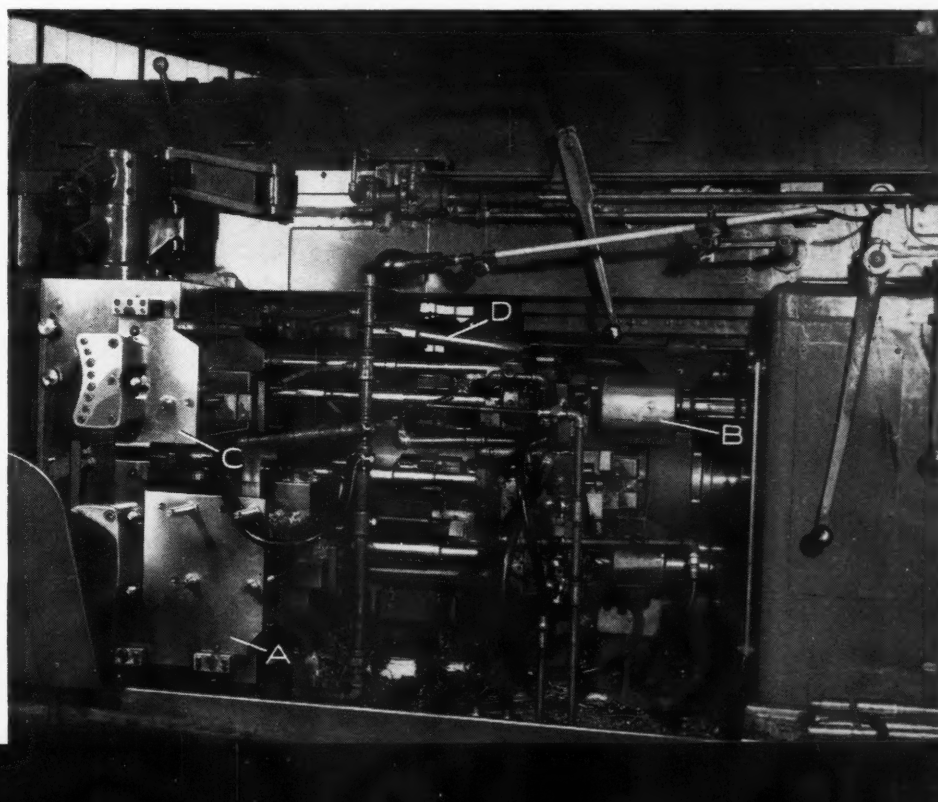


Fig. 4. An extra wide main cross-slide (A) holds form tools in the second and third positions. Center-drilling in the fourth position is accomplished by an accelerated drill attachment at (B). The fourth-position cross-slide is shown at (C), and the drive-shaft for the fifth-position oil-grooving operation is indicated at (D)

ting shown in the lay-out at the sixth and seventh stations.

A rough-forming cut is taken at the cut-off end of the bar in the sixth position. The form tool is mounted on the regular sixth- and seventh-position cross-slide. Four grooving blades are held in a holder on an auxiliary cross-slide that is somewhat heavier than the auxiliary cross-slide regularly used with these machines. The roll supports employed at this station are mounted on the main end-slide.

The turning and forming of the 1 3/16-inch diameter to between 0.940 and 0.950 inch is completed in the seventh position. A form tool at the cut-off end of the bar finish-forms this section with a feed of 0.0007 inch per revolution. Special support is provided for the work while indexing from this station to the eighth.

In the eighth position, a cut-off tool on the cross-slide severs the finished shaft from the bar. A feed of 0.0027 inch per revolution is used for this operation, after which the shaft is removed from the collet by a hydraulic attachment and conveyed out of the machine through a tube.

Among the advantages gained by producing the transmission main shafts in these automatic bar machines are the elimination of secondary operations, longer tool life (obtained by dividing the machining operations among several tools), and a high rate of production without the constant attention of skilled operators.

Huge Press that Weighs Over a Million and a Half Pounds

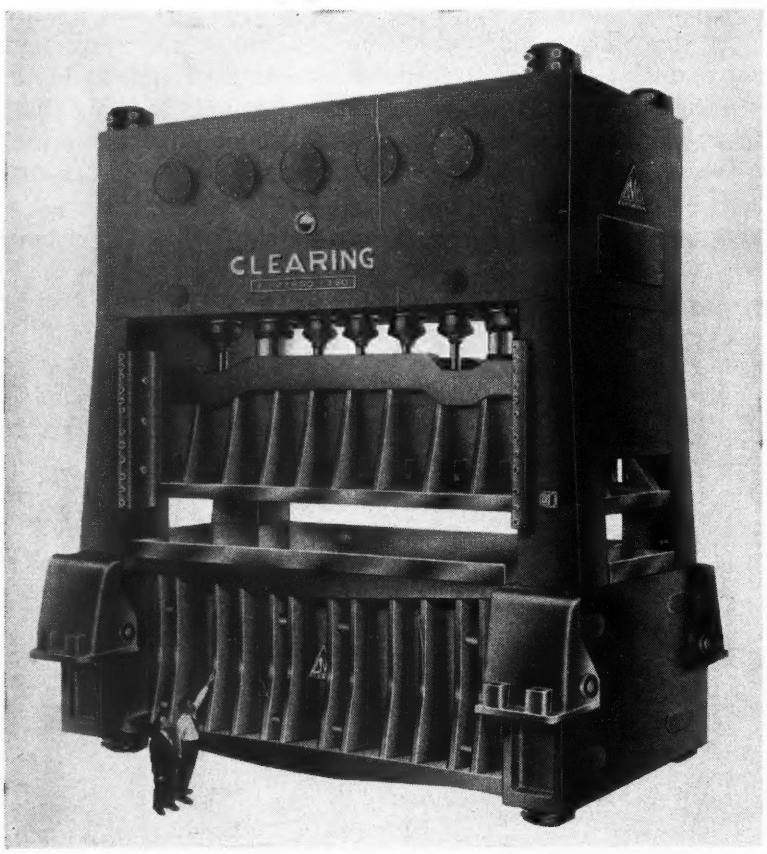
The largest metal-forming press of its type ever built has recently been shipped to France by the Clearing Machine Corporation, Chicago, Ill. This press, which is 38 feet in length and weighs over 1,500,000 pounds, presented a number of manufacturing and shipping problems. Because of its size, the press was not assembled in this country, and it is for this reason that an artist's drawing is shown here.

This huge press will be used in forming structural members for railway cars and busses. A 200-H.P. motor forces the slide downward with a maximum pressure of 3850 tons. The makers of this machine are now in process of building an even larger one.

* * *

Suggestion Awards Distributed by Westinghouse

More than 5000 employes of the Westinghouse Electric Corporation were participants in the distribution of $117,354 for suggestions during 1949. The employes submitted 26,295 ideas in the contest, of which more than one-third were usable. The highest award was $1280 for a suggestion pertaining to a new method of salvaging scrap plastic material.



Huge press recently built by the Clearing Machine Corporation for metal-forming operations in a French plant

Only Two Hundred Years Behind the Times!

PRODUCTION executives were amazed in reading a speech recently made by Philip Murray to find him attacking machines as the cause of unemployment. This bugaboo is resurrected periodically by demagogues who should and do know its fallacies. Even they must be aware of the fact that American industrial history has demonstrated conclusively that production machinery was the principal factor in developing our high standards of living. Without the use of machinery capable of maintaining and increasing the level of national productivity, our living standards would be certain to fall.

What makes national prosperity? The ability of people to buy large quantities of products at low costs made possible by the use of high-production equipment. Anyone who doubts this need only be reminded of the manifold benefits enjoyed by the citizens of these United States which are denied the inhabitants of other nations that are backward in applying modern manufacturing equipment.

Controversies regarding machinery and unemployment started as long ago as 1743, when hand weavers in England threatened to mob the inventor of the power loom. Near the close of the eighteenth century, a frenzied mob burned down a textile factory which had been equipped with 500 looms, and yet between 1830 and 1940 the number of workers in the English textile industry increased three and one-half times, while the population only doubled during the same period. The British Isles would be far better off today economically if there had been greater installation of production equipment in the last few decades.

Surely the president of the C.I.O. must know that the phenomenal automobile industry would be non-existent if people had to buy cars made by the machine tools of forty years ago. It was high-production machinery alone that brought automobiles within the financial reach of practically everyone in this country, and it is high-production machinery that enables manufacturers to sell automobiles today at prices that are low, compared with present high labor costs.

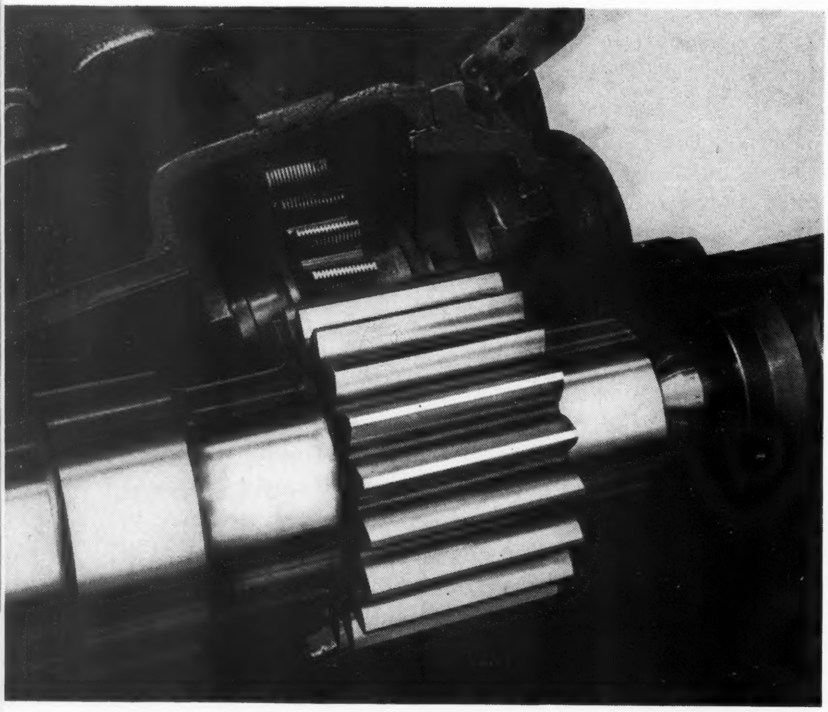
As David Ayr, president of the National Machine Tool Builders' Association and of the Hendey Machine Co., pointed out in challenging Mr. Murray's statement, the fact is that there is a direct ratio between excellence of machines and increased volume of employment. Good machines mean more employment, not less, because by increasing productivity per man, they cut costs. By cutting costs, they enable the manufacturer to sell a better product for the same price or an equally good product at a lower price. As people get more for their money, more people buy and the volume of manufacture goes up. As the volume of manufacture goes up more people are employed. It is a "beneficial circle."

Philip Murray is doing a disservice to his country in preaching a doctrine that has been disproved by practical experience extending over two centuries.

Charles O. Herb

EDITOR

Selection and Design of



First of a Series of Articles Presenting Methods and Formulas Employed in Designing or Selecting Shaving Cutters for Gears. These Methods and Formulas Can also be Applied, with Certain Modifications, to Hobs and Shaper Cutters

By W. H. BOOKMILLER
Gear Engineering Division
General Electric Co.

Fig. 1. A 3 diametral pitch pinion for a locomotive motor being finish-cut by a gear shaving tool

THE selection of the proper cutting tool for a gear is based on the same principles as those governing the original design of the tool. Thus when the methods used and problems encountered in designing tools are known and understood, the selection of a suitable tool for cutting teeth on a gear that may have slightly different cutting data from one previously cut is relatively simple.

The equations and methods presented in this series of articles can be used to solve some of the problems concerning the design and use of gear-generating tools. They apply to the general case of a rotary helical shaving cutter shaving a helical external gear. An internal gear requires certain sign changes in the formulas, while other tools (such as hobs and shaper cutters) and spur gears are simply special cases.

Shaving cutter problems will be solved to show how the formulas may be applied. A shaving cutter will be designed for a given gear, and calculations made to see if the cutter can be used for another gear made to the same normal section data but with a different helix angle. It may be mentioned here that the range of helix angles for which a cutter is applicable is limited by the necessity of maintaining a reasonable crossed-axis angle between the cutter and the gear.

It will be shown how to determine the diameter on the gear to which the cutter should shave and the relationship of the cutter outside diameter to cutter tooth thickness in order to shave to this diameter. Also, information will be given on how to check the design by calculating the penetration of the cutter into the gear tooth space and the contact ratio in the normal plane. The former calculation checks for possible root interference, and the latter to determine whether there is sufficient overlap to provide satisfactory shaving action. Finally, it will be shown how to determine if a cutter will shave a gear having somewhat different cutting data from that for which the cutter was designed. The change will be in the helix angle and plane of rotation, the normal pitch and normal pressure angle of the gear remaining the same.

Throughout these articles it will be necessary to refer to diameters at different points on the gear tooth surface. In order to simplify this reference, certain relatively new terms will be used that may not be familiar to all readers. These are:

Contact Diameter—The diameter at the point in the dedendum of a gear where the tip of the mating gear makes its first (or last) contact with the tooth surface.

Gear-Generating Tools

Form Diameter—The diameter at the point in the gear dedendum where the desired tooth form is to start.

Under-Cut Diameter—The diameter at the point where the maximum profile under-cut occurs as produced by a protuberance type tool.

Shaving Diameter—The diameter at the point in the gear dedendum where the shaved tooth surface starts.

First, consider the action of the different types of tools in cutting a gear. The motion of hob flutes through the teeth of the gear is the same as that of a rack rolling in mesh with a gear, while the rolling motion of a shaving cutter or a shaper cutter with a gear is similar to that of two gears rolling together. The only difference between the rolling of a cutting tool with a gear and two gears rolling together is that cutting tools normally work in "tight mesh" at varying center distances, while two gears usually operate with backlash at a fixed center distance. Since cutting tools are fundamentally similar to gears, the same rules and formulas will apply.

Gear-cutting tools, such as hobs and shaper cutters, are backed off to provide clearance back of the cutting edge. Personal observation will show that both the sides and the tips of the teeth are backed off. This is usually done in such a way that the proper relationship between gear tooth depth and tooth thickness is maintained throughout the life of the cutter and hob. There are special cases where this relationship is not maintained. Then it is necessary to compensate for the change in tooth depth-thickness relationship after each sharpening by either grinding the tool tip or allowing liberal variations in depth or tooth thickness.

Hobs and shaper cutters are available for rough- and finish-cutting teeth in the conventional way and with special cutting tooth modifications, such as protuberances, where gear teeth are to be finished by grinding or shaving.

Shaving cutters present a slightly different picture. A shaving cutter is essentially a gear with grooves cut into the tooth surface to provide a series of cutting edges across the face of each tooth. The cutting edges and tooth tips are not backed off, as in hobs and shaper cutters. Unlike the latter, only small amounts of stock are removed by the shaving cutter, and it may cut in either direction, depending on the rotation of the work and the cutter. The shaving cutter is sharpened by grinding the tooth profile to a new tooth thickness and grinding the outside diameter to suit.

Factors to be Considered in Design of Finishing Cutters

After a gear is cut with a protuberance type tool, the tooth surface is finished to the desired tooth form by grinding or shaving. The finished

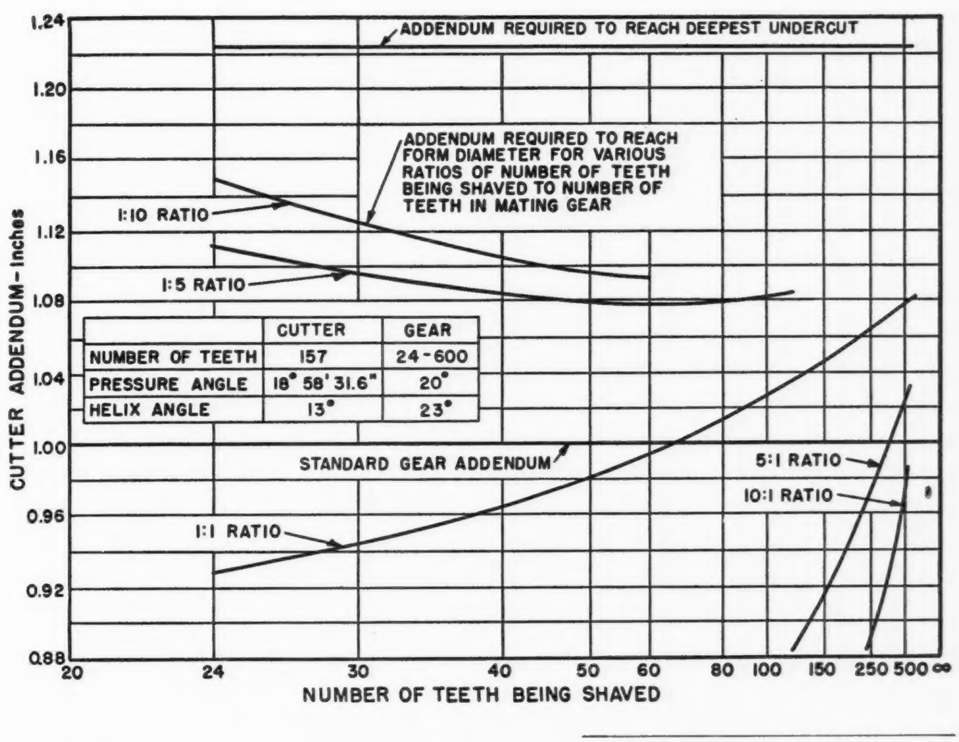


Fig. 2. Characteristic addendum curves for a typical shaving cutter

surface must start between the under-cut diameter and the form diameter and extend out to the tip of the gear tooth.

The best blend of the finished surface with the unfinished surface is obtained exactly at the under-cut diameter, though a satisfactory blend can often be obtained when the finished surface starts above the under-cut diameter. If the finished surface extends below the under-cut diameter, the root fillet radius will be notched, causing stress concentrations. If it starts too high on the tooth, there is likely to be interference between the gear dedendum and the mating gear tip.

Fig. 2 shows characteristic addendum curves for a typical shaving cutter. These curves are for a shaving cutter and preshaving tool rolling at the design pitch diameter of the gear. The upper curve, which is a straight line, shows the cutter addendum required to shave down to the under-cut diameter produced by the preshaving tool. This is the maximum cutter addendum, and is constant for all numbers of teeth on the gear being shaved for a given preshaving tool. The lower curves show the cutter addendum required to shave down to the form diameter for a wide range of numbers of gear teeth and several ratios. This group of curves represents the minimum addendum required on the shaving cutter.

It is obvious from Fig. 2 that the shaving cutter designer must have considerable information about the gears to be shaved and the preshaving tool in order to design a shaving cutter that will give the user the most for his money. For instance, a shaving cutter designed with the minimum addendum required to shave a 40-tooth gear which mates with a 200-tooth gear would not be suitable for shaving a 24-tooth gear that mates with a 240-tooth gear. On the other hand, if the designer does not know what the design of the preshaving tool is, he cannot risk interference by making the cutter addendum very much longer than the required minimum addendum.

Shaper cutters and hobs present design problems similar to those of shaving cutters. The distance from the pitch line to the protuberance high point on hobs and shaper cutters can be found by methods similar to those used to get the shaving cutter addendum. Curves like those shown in the chart can be drawn for this height. The required height is largest when the protuberance tool is cutting gears with small numbers of teeth that mate with gears having a large number of teeth, just as the shaving cutter addendum is largest for this condition.

The required addendum for a shaving cutter is, in most cases, greater than the standard gear tooth addendum for the pitch, as is shown in Fig. 2, and thus the tip of the cutter penetrates into the tooth space to a greater depth than the mating gear. The cutter addendum is often limited by the depth of this penetration. This problem becomes acute when shaving small gears that mate with large gears. As shown on the chart, this is the very same area in which the allowable range of cutter addendum is most limited. Since the cutter penetration decreases for external gears when the rolling pressure angle decreases, some shaving cutters are designed to roll at special pressure angles throughout the life of the cutter.

There is no penetration problem, as such, for hobs and shaper cutters, since they cut to the full depth of the teeth. The addendum of the hob and shaper cutter may be limited occasionally by the permissible gear root diameter, but it should be long enough to give a satisfactory root fillet.

Another factor that enters into the design of shaving cutters is the contact ratio. Since the tool- and work-spindles of a shaving machine are not geared together, the contact ratio between the shaving cutter and the gear being shaved must be equal to or greater than 1, and

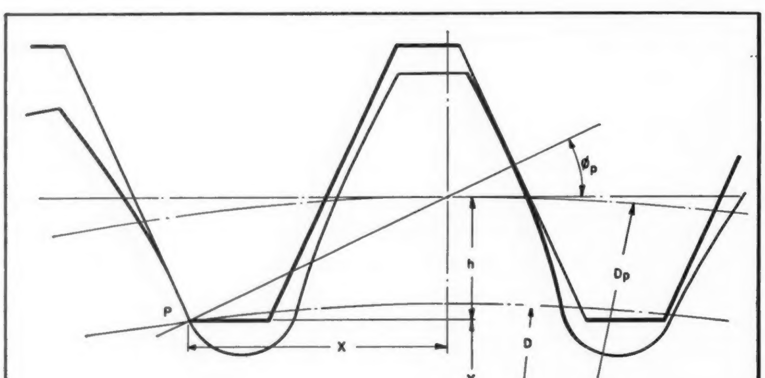
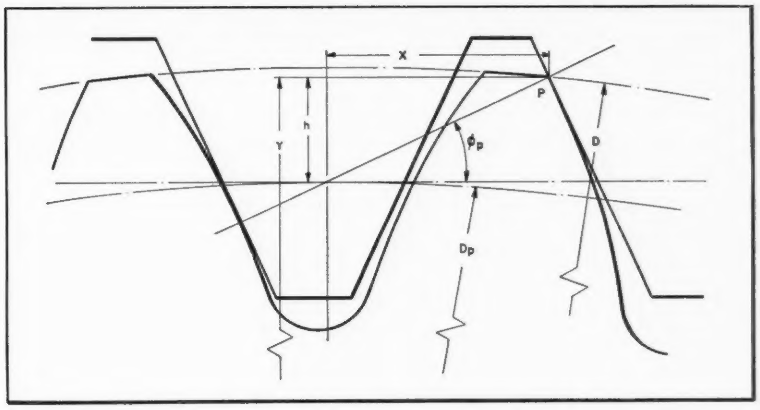


Fig. 3. Diagram showing rack and gear teeth in mesh. Common point of tangency (P) is at tip of rack tooth and near root of gear tooth

Fig. 4. Diagram showing gear and rack in mesh. Here common point of tangency (P) is at tip of gear tooth and near root of rack tooth



should be as large as practical for good shaving action. Since hobs and shaper cutters are connected through gearing to the part being cut, the relative rotations of cutter and work are independently maintained, and the contact ratio is immaterial for proper cutting action. In the case of hobs and shaper cutters, however, there must be a sufficient number of cutting flutes on the hob or cutting strokes taken by the shaper cutter within the cutting zone to produce a satisfactory finish.

The correct relationship of the tool outside diameter and protuberance location, where protuberances are used, to the tool tooth thickness must be known in order to manufacture and maintain hobs, shaper cutters, and shaving cutters capable of producing gear teeth of consistent quality throughout their useful life. This relationship can be readily established and charts made, so that whenever the tool is sharpened, it can be properly inspected.

Basic Considerations for Calculating Cutter Dimensions

There are three possible combinations of meshing gears and racks:

1. Two gears with a finite number of teeth each.
2. One gear with a finite number of teeth and a rack.
3. Two racks.

The last combination would probably never exist in actual practice, but can be utilized mathematically to provide a transfer mechanism for calculation purposes. These combinations can exist in two forms—either in a parallel-axis arrangement or in a crossed-axis arrangement. For simplicity in making calculations, Combination 1 can be considered as two Combination 2's tied together by Combination 3. Corrections that are necessary for a crossed-axis arrangement are made during the mathematical transfer through Combination 3. Figs. 3, 4, and 5 show racks meshing with gears and racks meshing with each other.

The gear and cutter can be thought of as two separate items and handled accordingly for much of the calculation work by keeping the following three rules in mind:

1. The product of the normal circular pitch and the cosine of the normal pressure angle must be the same for both gear and tool. (The normal circular pitch and normal pressure angle of the tool will usually equal those of the gear.)
2. The sum of the normal thickness of the cutter tooth and that of the gear tooth must equal the normal circular pitch less extra cutting and finishing allowances, if such allowances are made.
3. The axial pitch is constant for a given gear or tool at all diameters.

Calculation Procedure for Cutter Selection or Design

The calculation procedure required to obtain the relationship between the shaving cutter outside diameter and the cutter tooth thickness for a given gear is similar to that for determining the relationship between the gear shaving diameter and the gear tooth thickness for a given cutter. The procedure can be divided into six steps, as follows:

1. Calculate the maximum and minimum shaving diameters of the gear. The maximum shaving diameter will be equal to the form diameter, and the minimum shaving diameter will be equal to the under-cut diameter. The gear transverse tooth thickness is calculated when a shaving cutter is being designed for a given gear. The gear axial pitch is calculated when a shaving cutter on hand is being applied to a new gear design.

2. Determine number of teeth, pitch diameter, and helix angle of the shaving cutter. In general, the cutter helix angle depends on the crossed-axis angle desired, and the cutter pitch diameter on the shaving machine limitations.

Various other factors sometimes limit the range of choice, and experience will serve as a guide to obtain the best results. The number of teeth on the cutter depends on its normal circular pitch, helix angle, and pitch diameter, and should have no common factors with the number of teeth on the gear to be shaved. It is good practice to use a prime number. The cutter normal circular pitch and normal pressure angle will usually equal those of the gear. The exact pitch diameter, circular pitch, axial pitch, and pressure angle are then calculated.

If a cutter is on hand, the number of teeth, helix angle, normal circular pitch, and normal pressure angle are found from the cutter stamping. The normal tooth thickness and outside diameter are measured. The cutter pitch diameter, circular pitch, pressure angle, and transverse tooth thickness are then calculated.

3. Calculate the shaving cutter and gear tooth thicknesses, helix angles, and pressure angle at various rolling pitch diameters. It is usually preferable to assume a series of rolling pressure angles for the gear when starting from a given gear and designing a cutter for it. When starting from a cutter that is on hand and checking to see if it can be used for a given gear, it is preferable to assume rolling pressure angles for the shaving cutter. These assumptions are based on experience. The gear and cutter pitch diameters, crossed-axis angle, and change in tooth thickness desired affect the range needed. The other data are then calculated from these assumptions.

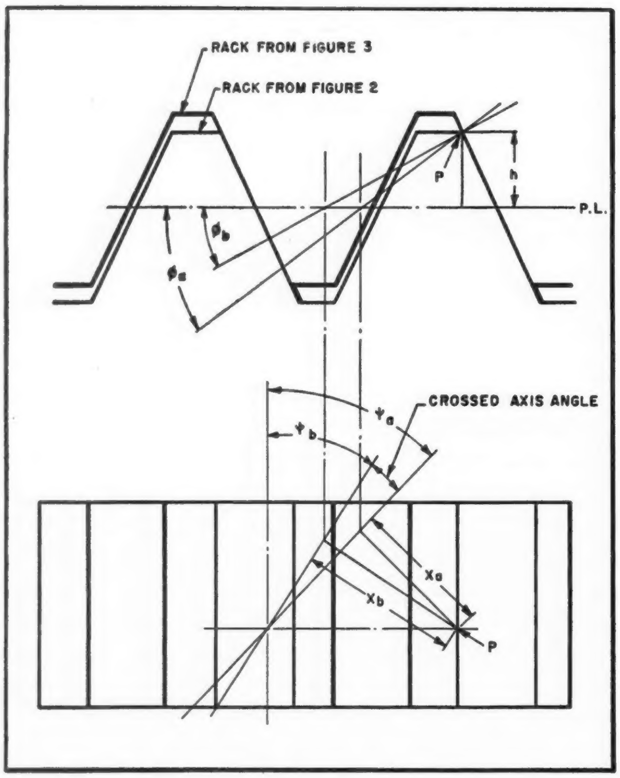


Fig. 5. Two views of two racks meshing together. This diagram is used as a basis for a mathematical transfer of data for rack shown in Fig. 3 to rack shown in Fig. 4 or vice versa

4. Calculate either the outside diameter of the shaving cutter required to shave to the shaving diameter of the gear or the shaving diameter on the gear that will be produced by the outside diameter of a given cutter. This is done for each of the rolling pitch diameters used in Step 3.

5. Calculate working depth and contact ratio of the shaving cutter and gear for each of the rolling pitch diameters used in Step 3 to check further the suitability of the proposed design.

6. Repeat the foregoing steps as needed to provide sufficient data for determining the cutter dimensions that will best meet the design requirements.

Fundamental Equations

Considering now the general case of a helical gear or tool, the following fundamental equations can be written that will apply to both:

$$p_t = \frac{\pi D}{N} \quad (1)$$

$$p_n = p_t \cos \psi \quad (2)$$

$$p_x = \frac{p_n}{\sin \psi} \quad (3)$$

$$\operatorname{Tan} \phi_n = \cos \psi \tan \phi_t \quad (4)$$

$$t_n = t \cos \psi \quad (5)$$

where

D = diameter;
N = number of teeth;
p_t = transverse circular pitch;
ψ = helix angle;
p_n = normal circular pitch;
p_x = axial pitch;
ϕ_t = transverse pressure angle;
ϕ_n = normal pressure angle;
t = tooth thickness; and
t_n = normal tooth thickness.

Equations (2) to (5) are applicable for any given diameter D.

The following equations show how the plane of rotation data varies with the diameter:

$$\operatorname{Tan} \psi_1 = \frac{D_1}{D_2} \tan \psi_2 \quad (6)$$

$$\operatorname{Cos} \phi_1 = \frac{D_2}{D_1} \cos \phi_2 \quad (7)$$

$$p_{t1} = \frac{D_1}{D_2} p_{t2} \quad (8)$$

$$t_1 = \frac{D_1}{D_2} [t_2 + D_2 (\text{inv. } \phi_2 - \text{inv. } \phi_1)] \quad (9)$$

For the special case of a rack, Equation (9) becomes:

$$t_1 = t_2 - 2\triangle h \tan \phi_t \quad (9A)$$

where $\triangle h$ = difference in height on the rack tooth of the locations of t_1 and t_2.

Equation (9A) applies to any section through the rack, provided both tooth thickness and pressure angle are taken in the same plane.

The common point of tangency P between gear and tool profiles lies on the line of action, which is a straight line for involute gears, and on circles whose centers are the axes of the gear and tool. The circle centered on the gear axis could be the shaving diameter of the gear, and the circle centered on the tool axis could be the outside diameter of a shaving cutter required to shave to the gear shaving diameter. In this case, the line of action, the shaving diameter of the gear, and the outside diameter of the shaving cutter intersect at a common point, which is also the point of tangency for the profiles of the gear and shaving cutter. When either the gear or tool becomes a rack, the circles become straight lines parallel to the rack pitch line. Figs. 3 and 4 show a rack mating with a gear. Fig. 3 shows point P at the tip of the rack tooth and near the root of the gear tooth. Fig. 4 shows point P at the tip of the gear tooth and near the root of the rack tooth.

From both Figs. 3 and 4 we can write the following equations (h being negative in Fig. 3):

$$Y = h + \frac{D_p}{2} \quad (10)$$

$$X^2 + Y^2 = \left(\frac{D}{2}\right)^2 \quad (11)$$

$$h = X \tan \phi_p \quad (12)$$

where

ϕ_p = pitch line pressure angle;
D_p = pitch diameter;
D = diameter at P from center of gear;
X = abscissa of P from radial line through intersection of the line of action with the pitch diameter;
Y = ordinate of P from center of gear along radial line used for X; and
h = ordinate of P from pitch diameter along radial line used for X.

Equations (10), (11), and (12) may be solved for X and h. The solution for X is written in equation form as:

$$X = \frac{\sqrt{D^2 (1 + \tan^2\phi_p) - D^2_p} - D_p \tan \phi_p}{2 (1 + \tan^2\phi_p)} \quad (13)$$

The value of h may then be found from Equation (12).

Fig. 5 shows two views of two racks meshing together. This represents the racks from Figs. 3 and 4 being meshed together, so as to make possible a mathematical transfer between them in either direction.

The numerical value of h will remain the same during the transfer between Figs. 3 and 4, but its sign changes. In Fig. 3, h is always negative, while in Fig. 4, h is always positive.

The numerical value of X will be different for Figs. 3 and 4 in crossed-axis gearing if the plane of rotation pressure angles vary. Equation (12) shows the relationship between X and h. The pressure angle is always positive.

It is necessary to know how far the tip of the tooth of a tool such as a shaving cutter penetrates into the tooth space of the gear in order to make adjustments when necessary to avoid interference with the root fillet. Equation (14) gives this depth.

$$h_k = 1/2 [(d_o - d_1) + (D_o - D_1)] \quad (14)$$

where

h_k = working depth of tool;
d_o = outside diameter of tool;
D_o = outside diameter of gear;
d_1 = rolling pitch diameter of tool; and
D_1 = rolling pitch diameter of gear.

Just as two gears with a high contact ratio will operate better than two with a low ratio, a cutter will produce better results if its contact ratio with the gear being cut is also high. The normal-plane contact ratio can be calculated by means of Equation (15):

$$m_p = \frac{\dfrac{X_G}{\cos \psi_G} + \dfrac{X_C}{\cos \psi_C}}{p_n \cos^2 \phi_n} \quad (15)$$

where

m_p = contact ratio (normal plane);
X_G = abscissa of the intersection of the line of action with the gear outside diameter measured from a radial line as shown in Fig. 4; and
X_C = abscissa of the intersection of the line of action with the cutter outside diameter measured from a radial line as shown in Fig. 4.
ψ_G = helix angle of gear;
ψ_C = helix angle of cutter;
p_n = normal circular pitch of gear and cutter; and
ϕ_n = normal pressure angle of the gear and cutter.

The values of X_G and X_C are calculated from Equation (13) using D equal to the outside diameter and D_p equal to the rolling pitch diameter.

The helix angle, normal pressure angle, and normal circular pitch are also taken at the rolling pitch diameter.

It is often helpful, when one of the pressure angles is standard, such as 20 degrees, to tabulate, as shown below, values of inv. ϕ_2 — inv. ϕ_1 and cos $\phi_2 \div$ cos ϕ_1 for a small range of pressure angles near this standard. As seen from Equation (7), cos $\phi_2 \div$ cos ϕ_1 is equal to $D_1 \div D_2$, which also appears in Equations (6), (8), and (9). The symbol m is employed to represent cos $\phi_2 \div$ cos ϕ_1 and θ to represent inv. ϕ_2 — inv. ϕ_1.

ϕ_1, Degrees	m	θ
	Cos $\phi_2 \div$ Cos ϕ_1	Inv. ϕ_2 — Inv. ϕ_1
23	1.020845	— 0.008145
22	1.013491	— 0.005149
21	1.006547	— 0.002440
20	1.000000	0
19	0.993838	+ 0.002189
18	0.988051	+ 0.004144
17	0.982629	+ 0.005879

$\phi_2 = 20$ Degrees

The second article in this series will describe, step by step, the application of these formulas to the design of a shaving cutter for a specific gear.

* * *

Common Causes of Gear-motor Trouble

In an article recently published in *Westinghouse Maintenance News,* it was pointed out that, in the majority of cases where difficulties with gearmotor installations have been reported, a check has shown that the trouble is a result of abnormal loads or adverse operating conditions imposed on the gearmotor by the connected or driven equipment. A well organized maintenance program should be established for the unit, so that the connected or driven equipment can be checked at the first sign of irregularity in the operation of the gearmotor.

If the gearmotor is driving the connected equipment through a sprocket, a belt pulley, or a pinion mounted on the output shaft of the gearmotor, the center of the face of such an overhung member should be located at the center of the shaft extension of the gearmotor. For example, a pulley with a hub which allows the center of the face of the pulley to extend beyond the end of the output shaft will create an excessive overhung load on the bearings of the gearmotor if the unit is loaded to capacity.

If the gearmotor is connected to the driven equipment by a sprocket or chain drive, the center line of the two sprockets or pulleys should never be in the vertical plane but always in the horizontal plane. In any type of chain drive, the chain will stretch. But when driving in a vertical plane, the chain stretch permits the chain to slip over the teeth of the lower member. This will result in serious shock loads and may cause premature failure of both the gearmotor and the driven equipment.

When a pinion is mounted on the output shaft of the gearmotor for gear drive or connection to the driven equipment, it is important that the area of contact on the pinion teeth be well distributed over the entire face width of the pinion and uniform from the outside to the inside of the pinion faces. The mesh of the pinion teeth with the mating gear teeth should be adjusted to permit lubrication without taking up the full amount of backlash.

The loads imposed upon a gearmotor when driving the driven equipment through such a connection are reflected back into the generator. These loads are, of course, relative to the amount of load required to drive the driven equipment plus any abnormal load created by the grade of gearing or the accuracy of the pinion and gear. For example, if a cast-tooth pinion is meshing with a cast-tooth gear, the loads will probably be extremely high because of the inaccuracy of cast-tooth gearing. In this instance, a gearmotor that would normally have quiet operation would probably be very noisy.

On the other hand, with a very accurately manufactured pinion on the output shaft of the gearmotor meshing with a gear of comparable quality on the driven equipment, the load on the gearmotor would be considerably more uniform and the operation would compare favorably with the performance of a gearmotor coupled to the driven equipment.

It is important in checking noisy operation of a gearmotor to investigate thoroughly the method of transmitting the load from the gearmotor to the driven equipment as well as the accuracy of the parts used.

* * *

SKF Offers New Courses to Employes

S K F Industries, Inc., manufacturers of ball and roller bearings, have recently made available to its employes three new courses of study covering advanced mathematics, statistical graphs, and metallurgy. This is part of the employe education project started by the company last October. About 10 per cent of the firm's 3000 employes are taking these "after hours" courses.

Angle-Setting Vise for Tool Grinding

THE angle-setting vise shown in the accompanying illustration was designed for use in grinding tools, and has proved an aid to small shops that are not equipped with such devices as optical projectors and profile grinding machines. It supplements standard equipment for the quick production of tools required in small lots.

The vise can be manipulated in three planes. A cradle type frame *A* is mounted on a base *B* by means of a hinge-pin *H*. It can be set and locked to any angle on the scale surrounding the pin *H* either by the support strips *T* or by gage-blocks placed between the roller *R* and the pad *P*.

Movement in another direction is provided by segment *F*, which is fitted to a hollow spindle running through the frame; this segment can be set and locked by the scale S_2 and bolt *K*. Fitted to segment *F* are a fixed jaw J_1, which can also be set at an angle by the scale S_3, and a clamping jaw J_2, which pivots to accommodate the position of the fixed jaw. This moving jaw is operated on the hollow spindle by the screw W_1, which engages the nut N_1 and is operated by the handle U_1.

The tool is set for the proper rake by scale S_1. In the case of single-point tools, specified rake angles can be ground across the top face of the tool in a plane parallel to the surface of the machine table by using the adjusting scales S_1 and S_2 to position the tool. This is done by turning S_2 to the specified back rake angle and then adjusting S_1 to the compound angle required to obtain a given side rake angle.

Many tools can be finished without being removed from the vise, an advantage when only the base of the tool is ground and there are no other locating surfaces. By using a cup-wheel and setting the scales S_3 and S_2, the relief and clearance angles of a single-point tool can be ground without moving the tool.

Another useful attachment is the wheel-forming device on the end of the vise. This diamond wheel-dresser consists of a sliding block *V*, which carries a spring-loaded plunger *G*. A knife-edge follower actuates the plunger as it moves across a templet which is held in place by the hand-nuts *X*. The grinding wheel is then dressed to the required form by manipulation of the handle U_2. While this is not the most accurate method of grinding a form, it works well for simple shapes. Without using a templet, the diamond can be employed to true up the wheel in the usual way.

In small shops, this inexpensive vise can simplify and speed up the supply and maintenance of those special tools that require a high degree of accuracy. A. R. S.

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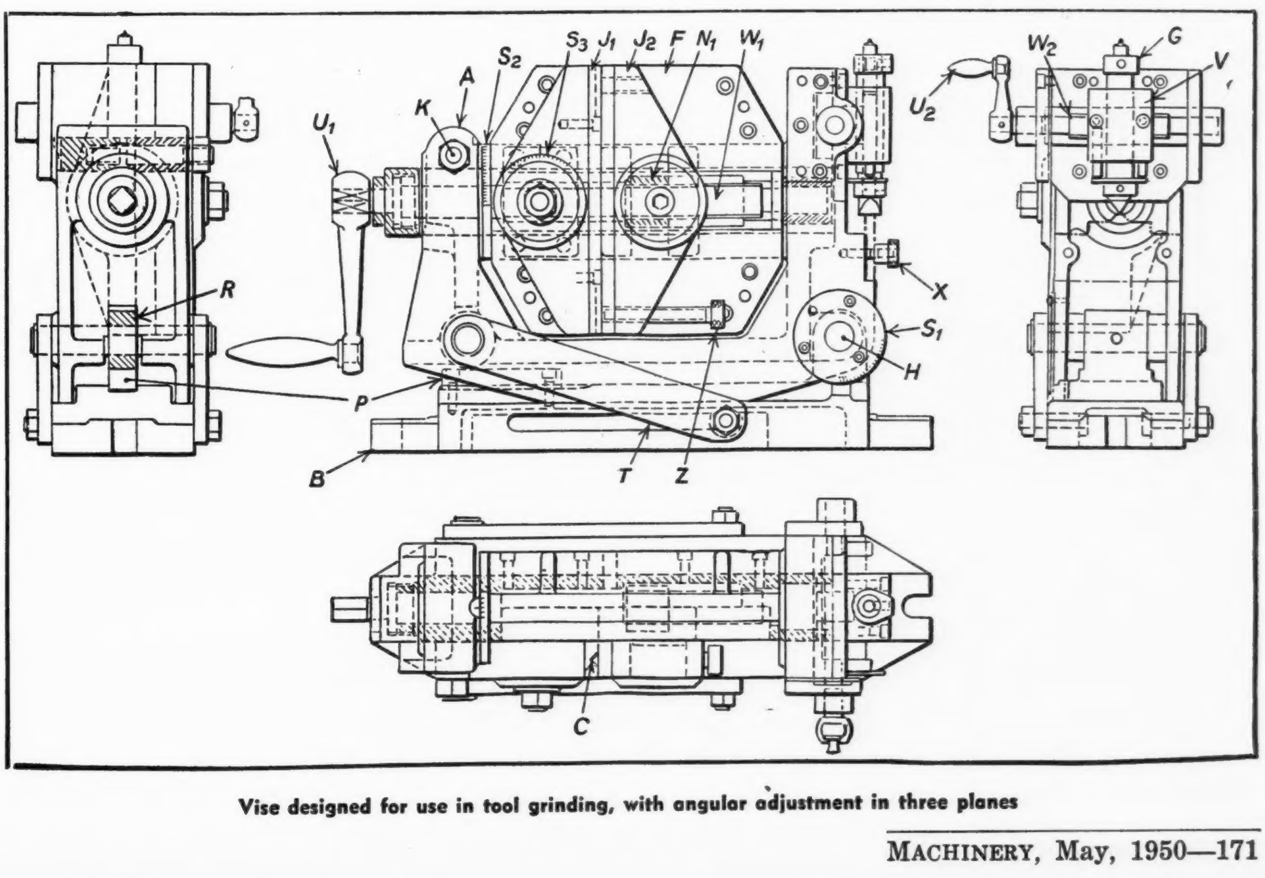
Since 1790, when the first U. S. Congress authorized the establishment of the Patent Office, 2,650,000 inventions have been patented.



Vise designed for use in tool grinding, with angular adjustment in three planes

Engineering News

Atomic Energy as a Future Source of Industrial Power

Atomic energy may be, ultimately, a source of vast amounts of industrial power, according to Harry A. Winne, vice-president in charge of engineering policy of the General Electric Co., in a recent address. At present, because of many factors that cannot be accurately evaluated, a reliable estimate of the cost of "nuclear fuel" cannot be given.

There is a possibility that, in time, it may be competitive with coal or oil, although there is no hope that real reductions in power costs by using atomic or nuclear energy would result. However, it might bring economical electric power to areas where the transportation costs of ordinary fuel are extremely high. Mr. Winne mentioned that a locomotive driven by atomic power could run long distances without refueling, and an atomic-powered ship could cruise for months without refueling the power plant.

In a few years, the Knolls Atomic Power Laboratory, operated by the General Electric Co., expects to have running a small experimental atomic power plant, actually generating electric power, although it will take many years before this will evolve into a full-scale plant.

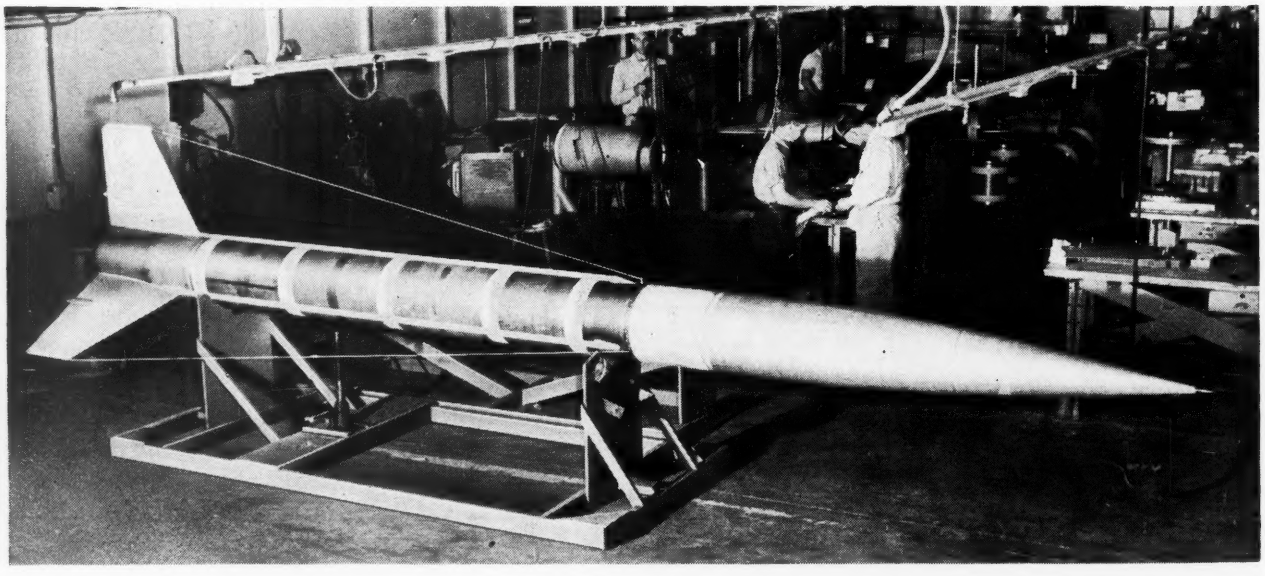
Natural Gas Suitable as a Turbine Fuel

It has been found that natural gas, as well as liquid fuels, can be utilized to power the Boeing light-weight gas turbine for industrial applications. Sponsored by the Navy Department's Bureau of Ships, the 200-pound, 175-H.P. engine is now undergoing service tests under controlled conditions, and has been successfully run on propane gas during the tests. Service application of each specific fuel obviously would require different fuel feeding and governing methods, as well as burner jets of various sizes, types, and location. However, the engine has shown remarkable fuel versatility, and is completely non-sensitive to octane or cetane ratings.

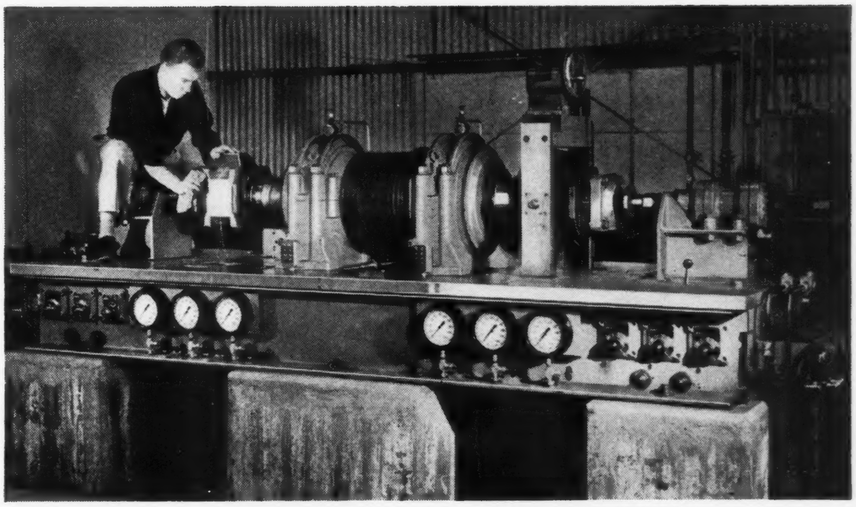
Used as a pipe-line unit, the new engine might well have application in the natural gas industry, saving considerable cost and complication. Other jobs for which it should prove readily adaptable are as power units for trucks, tractors, earth-moving machinery, cabin cruisers, speed boats, and launches or small barges.

The principal advantage of this engine over reciprocating types is its small size and weight, which makes it well adapted for stationary power uses. It is at least 3000 pounds lighter than

Assembling parts for the Aerobee 3000 miles per hour high-altitude rocket in the experimental department of the Ryan Aeronautical Co., which is building most of the assemblies for this pencil-thin guided missile, with the exception of the propulsion unit and fuel tank. In the latest research project, these rockets will be used by the Air Force at Alamogordo, N. M., for a two-year high-altitude study of cosmic rays, meteorology, radio characteristics, and other unknown facts about the thin upper atmosphere. Experience with the sixty rockets to be fired at Alamogordo is expected not only to furnish new information about conditions 75 miles above the earth, but also to supply technical data on which further guided missile developments will be based



Machine for testing railway-car journal-box bearing lubricant, which is used in the Beacon, N. Y., laboratories of the Texas Co. This equipment simulates actual operating conditions for railway car bearings, and can impose vertical loads up to 50,000 pounds and an axial load of 15,000 pounds on each of two journal bearings. All loading is accomplished hydraulically. To minimize vibration and noise, the machine is erected on concrete piers that are sunk 6 feet into the ground



present Diesel truck engines of equal output, taking into account the radiator, cooling water, clutch, and auxiliary transmission which the turbine eliminates, and it has about one-tenth as many parts as conventional gasoline- or oil-driven engines of comparable horsepower.

Silver Plating Acts as a "Lubricant" in Jet-Engine Bearings

Silver and tin, two metals far apart in value, are being effectively employed in solving lubrication and corrosion problems in high-speed aircraft engines. The metals are used as thin deposits on precision bearings produced by S K F Industries, Inc., for use in jet and piston type engines.

Plating the bronze retainers of roller bearings with silver lessens the chance of "seizing" when operating under extremes of speeds and temperatures, such as those encountered in jet planes. That is because the silver coating, which is 0.001 inch thick, acts as a "dry" lubricant. These retainers are in bearings that support the main turbine shaft of the jet engine. The silver coating is 99.99 fine, far purer than sterling.

The races and rollers of such bearings in piston type engines are tin-plated to prevent water from rusting the highly polished precision parts. The tin coating is even thinner, being only 0.00003 inch thick.

Extremely Fine Wire Produced by Electrochemical Process

A new method of making fine wire—less than one-tenth the thickness of human hair—has been developed at the Armour Research Foundation of the Illinois Institute of Technology. In cooperation with the Naval Ordnance Laboratory, Foundation scientists have produced 0.00015 inch diameter wire in the laboratory. The process consists of passing wire through a chemical bath in which an electric current is flowing. The wire acts as an electrode in an electropolishing bath, the surface being polished away and the metal dissolved until the desired size is obtained.

One application of fine wire made in this way may be in the production of smaller, more compact electronic equipment. Delicate scientific instruments could also be made more sensitive with extremely thin wire. The Foundation plans further research to determine how the process will work with various metals and just how fine a wire can be made and used practically.

Phenomenal Advances in Electronics Portrayed by Changing Spectrum

The phenomenal advances made in electronics during the last fifty years have been pictured in two charts, one for 1900 and the other for 1950, prepared by Harry F. Dart of the Lamp Division of the Westinghouse Electric Corporation, Bloomfield, N. J. In 1900, only a small portion of the spectrum was in use through electric power frequencies and carbon filament and arc lamps. But today most of the spectrum has been utilized. Some parts are overcrowded and overlap, while other portions remain shrouded in mystery.

The modern spectrum starts with the frequencies associated with electric power, such as are used in induction and dielectric heating; next depicted on the chart are radio waves and an infra-red section; then visible light and an ultraviolet section; and finally, a wide range of frequencies called X-rays, which include gamma rays and cosmic rays, the last presenting the greatest mystery, as they are known only by a few measurements made of the peculiar radiations from inter-stellar space.

The Use of

TOOLING costs are the first consideration in planning the production of a new product. When stampings are required, the quantity needed determines the type of dies or the production methods to be used. The point of volume production at which a line can be drawn in favor of one method or another is difficult to determine. However, any type of die, whether for production runs or for a relatively small quantity of parts, must be made in the most economical manner possible in order to keep costs per unit at a reasonable level.

It has been estimated that approximately 75 per cent of the products manufactured in America involve quantities ranging from 10,000 stampings down to as few as 10. Since 10,000 pieces are generally regarded as the minimum number for which conventionally made production dies are economical, there remains a wide range of work for which inexpensive dies must be used.

A method of diemaking developed by the DoAll Company, Des Plaines, Ill., that is particularly advantageous where low-volume production is involved entails the use of contour saws and files to produce a die and punch from the same piece of steel. The economy of utilizing the slug removed from a die cavity as a punch for that die is obvious. Three different dies made in this manner are illustrated in Fig. 1. A brief outline of this technique follows.

As shown in Fig. 2, a starting hole for the saw is made inside the die lay-out line. This hole is drilled in the die-block at an angle, intersecting the lay-out line at the center of the die-block and emerging on the opposite side outside of this line. After the narrow-blade precision saw has been inserted through the starting hole, the ends are welded together. The machine table is tilted at an angle that is a few degrees less than the angle at which the hole has been drilled, and the slug is completely sawed out at this angle. Since the path of the saw at the upper surface is entirely inside the lay-out line, with the proper cutting angle the bottom of the slug removed from the resulting cavity will have stock outside the die lay-out line. This excess stock is removed from the slug to produce the straight sides of a punch, and its removal from the die makes a land.

The angle of the saw cut and the drilled hole in which the saw is started depend upon the die thickness, and the cutting angle can be varied to produce more or less die clearance, as desired. After filing the die and laying out the large end of the punch for filing to fit the die, both members are secured to a die set in the usual manner.

The time and material saved by this technique in making the relatively small dies shown in Fig. 1 do not amount to a great deal, but the economy of this method increases considerably with the length of cut and the thickness of the material. For example, if a punch and die were

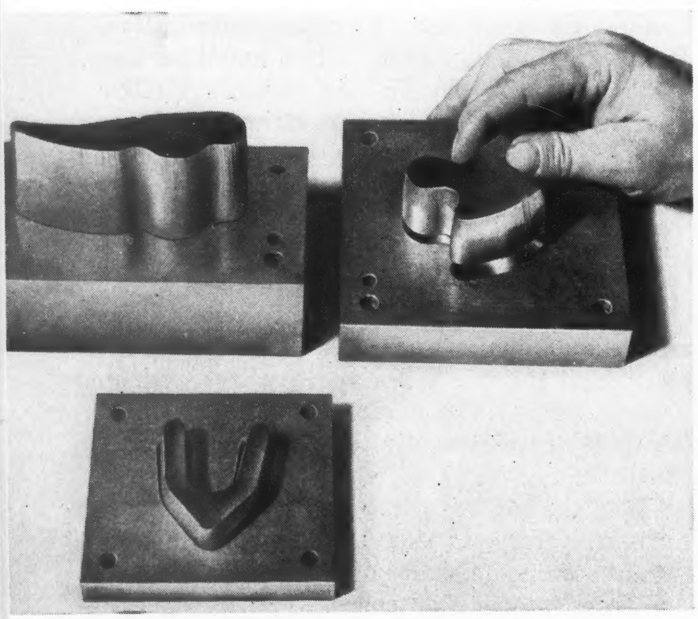


Fig. 1. Three small dies produced by contour sawing, the slug removed from the die cavity being utilized for the punch

Contour Saws in Diemaking

cut simultaneously from a die-block 12 by 8 by 2 inches with 40 lineal inches of die contour at a cutting rate of 1/8 lineal inch per minute, the time required would be five hours and twenty minutes. Obviously, twice this time would be required to cut the punch and die separately. Ordinarily, it takes considerably more time to make a comparable punch and die by other machining methods.

Among the principal advantages gained by this method is the fact that fewer strains are produced in the steel than occur with other machining methods. Moreover, material is saved in producing the punch, and the time ordinarily spent in filing die clearance is eliminated. This method of diemaking is widely used in the construction of forging, progressive, lamination, trimming and blanking, and other high-production dies, as well as those used for small quantity purposes.

When die thickness requirements allow its use, precision ground die steel has proved to be economical in diemaking practice, since it eliminates the time spent in squaring the sides and shaping the surfaces of ordinary flat stock, together with the waste of material normal to these operations.

This material is usually ground to an accuracy of within 0.001 inch of nominal thickness and width, and its availability in a wide range of analyses, pre-inked to facilitate die lay-out, makes it an ideal material for the construction of relatively thin dies. Precision ground die stock is particularly adaptable to the contour sawing method of making dies, and by its use, combined with the technique of making a punch and die from the same piece of steel, the cost of conventional dies is sharply reduced, so that they can be made economically for use in small quantity production.

Another application of contour sawing, using ground die stock, is in making dies and punches for the "Continental" method of producing small quantities of stampings. This method utilizes a thin die, actuated by a shuttle, and a slug from the die for the punch. The punch is laid on a guide plate which positions it for the operation before each stroke. The die and locating plate form a unit separated by a spacer of somewhat greater thickness than the strip to be punched. The assembly is attached to a "die sweep," the purpose of which is to carry the die into and out of position between the two platens of the press.

After the strip is fed into position between the die and the punch guide plate, the punch is laid on the guide plate. By means of the "die sweep," the die assembly is then moved into position between the platens and the press is tripped. Since the die clearance provided by the angular cut made by the saw is sufficient to pass the punch freely through the die, on the operating stroke of the press, the punch is forced through

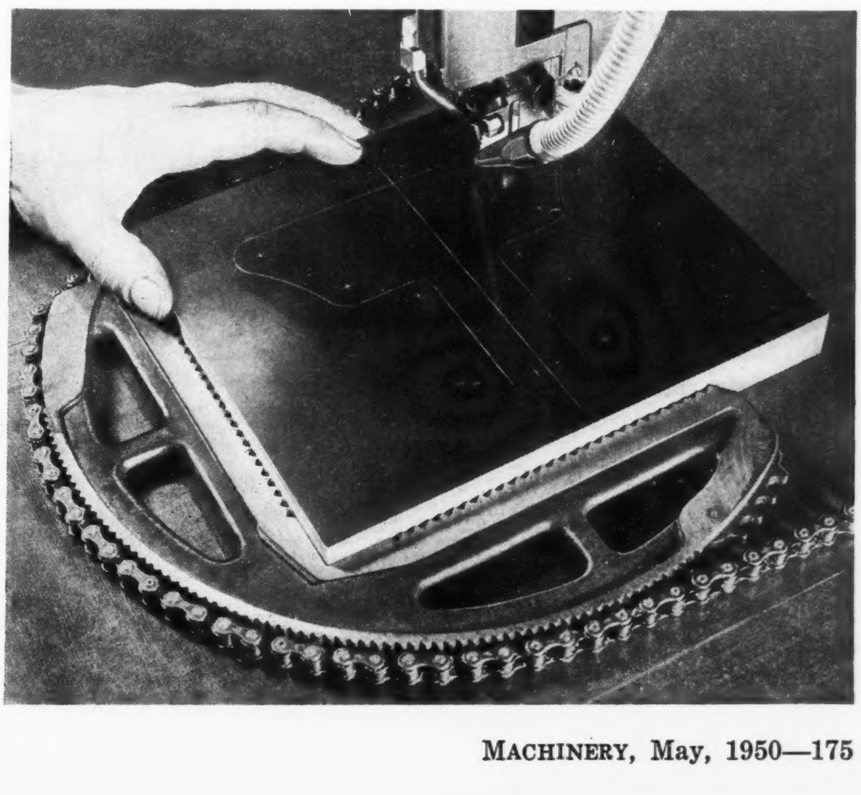


Fig. 2. In making a punch and die from one piece of steel, the contour of a die, laid out on the surface of the die-block, is cut on a contour saw at an angle to provide die clearance and stock around the punch contour

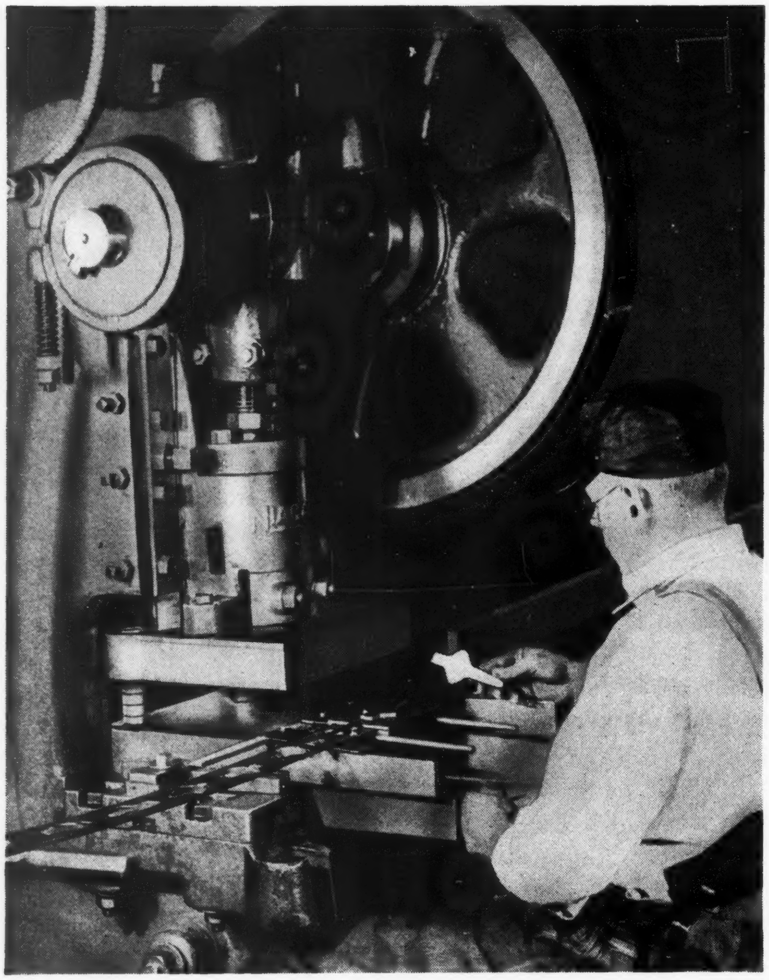
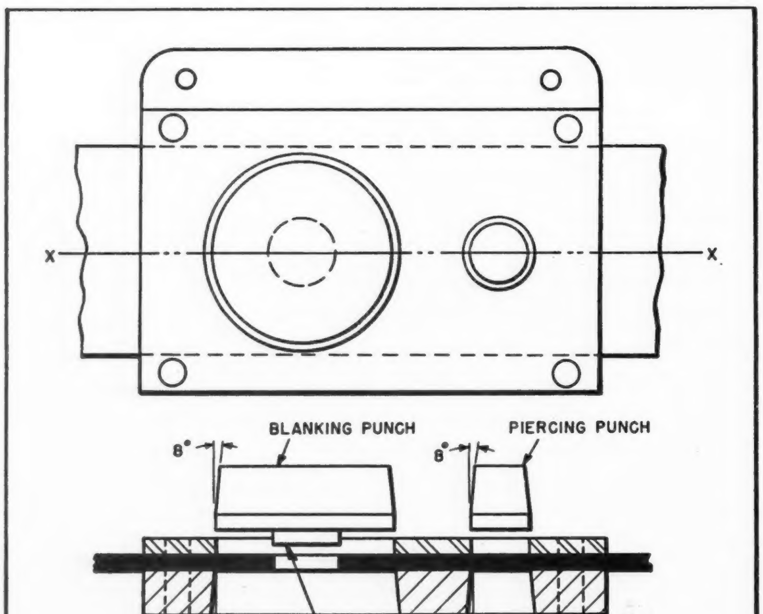


Fig. 3. The "Continental" method of producing stampings utilizes a slug from the die cavity as the punch. This is placed in a guide plate on the stock strip and passes through the die each time a blank is made



the die, and together with the finished blank, drops into a pan, after which the die is swept forward out of its position between the press platens. This operation is illustrated in Fig. 3, where an operator is shown replacing a punch on a strip after removing it from the pan. A typical die used in the "Continental" process is illustrated in Fig. 4.

Although the production rates with this method of making stampings are considerably lower than those obtained by the use of conventional methods, and labor costs are therefore correspondingly higher, the "Continental" process has some other advantages, in addition to low die cost. Because the punch is lying on the strip at the time of impact, it absorbs the entire blow, thus minimizing distortion of the blank. Stampings produced in this manner have an evenly balanced break and considerably less burr than those produced by conventional methods; moreover, less wear occurs at the cutting edges and sides of the tools.

Further advantages include the small amount of set-up time and the small storage space needed for punches and dies of this type. Since the operator actuates the "die sweep" mechanism to move the die in and out of the press, his hands are out of danger during the blanking stroke.

* * *

Association of Engineering Companies Elects New Officers

The National Association of Engineering Companies, at a recent meeting in Detroit, Mich., elected the following officers for the coming year: President, Harry L. Murray, of the Murray Engineering Co.; vice-president, Walter W. Schmitt, Product Engineering Service, Inc.; and secretary-treasurer, Walter R. Jackson, Modern Engineering Service Co.

Fig. 4. A typical progressive blanking and piercing die, made from precision ground die steel, which is used in the "Continental" method of stamping

Designing Light-Alloy Forgings

Selection of Aluminum and Magnesium Alloys for Forging, and Important Points to be Considered in Designing Such Forgings

By G. D. WELTY
Product Manager of Forgings
Aluminum Company of America

THE choice of a specific aluminum or magnesium alloy for any particular forging depends upon the properties desired, the operating conditions to which the forging will be subjected, and the ease of fabrication, or cost of manufacture, of the alloy. A few of the many light-alloy forgings produced at the Cleveland Works of the Aluminum Co. of America for the aircraft industry are seen in Fig. 1. Included in this group are a turbo-supercharger impeller, several types of bearing caps, a connecting-rod, two designs of pistons, a link-rod, and miscellaneous flanges and couplings.

The aluminum alloys most commonly employed for forging are 14S, B18S, A51S, and 75S. Crankcase sections for radial aircraft engines, cylinder muffs, and other shapes are made from A51S alloy because it is the easiest aluminum alloy to forge, has good machinability, moderate mechanical properties, and satisfactory dimensional stability at moderately elevated temperatures. Impeller wheels for radial-engine superchargers and turbo-jet engine compressors, as well as high-strength air-frame fittings, are made from 14S alloy because of its good mechanical properties and forgeability.

Aircraft pistons and cylinder heads, which require a great degree of dimensional stability, good thermal conductivity, and high mechanical properties at elevated temperatures, are made from B18S aluminum alloy. This alloy is more difficult to forge than A51S or 14S, but has good machinability. Alloy 75S is a high-strength alloy that is very difficult to forge. Its application is restricted to parts such as landing-gear members, spar caps, and frame forgings, where the greatest possible strength is required.

Typical aircraft parts sometimes forged from

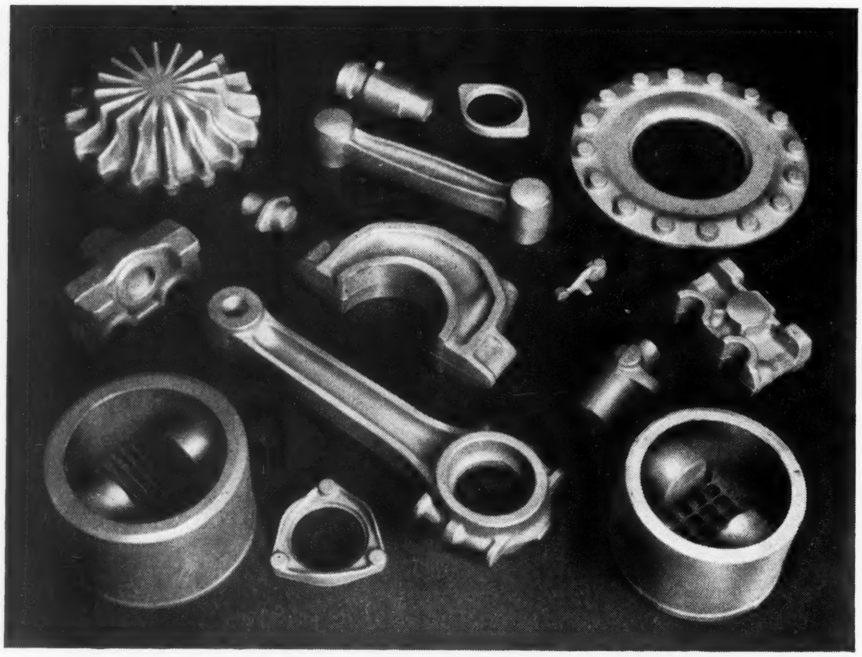


Fig 1. Typical aircraft engine parts forged from high-strength aluminum alloys, including an impeller, bearing caps, pistons, a connecting-rod, and several flanges

magnesium alloys include bearing caps, fuselage fittings, landing-wheel parts, and hydraulic pump bodies, cylinders, and control fittings. American Magnesium Corporation alloys commonly employed for forging are AM65S, AM-C57S, and AM-C58S (A S T M magnesium alloy designations AT35, AZ61, and AZ80, respectively).

These alloys are given in their order of forgeability, AM65S having the lowest fabrication cost. Magnesium forging alloys have excellent machinability, being similar in properties to A51S aluminum alloy. Such alloys do not respond to heat-treatment, and their mechanical properties are dependent upon the fabricating method. The terminology commonly employed in referring to forgings and dies is shown in Fig. 2.

Standard Tolerances Applied to Light-Alloy Forgings

Standard dimensional tolerances have been applied to light-alloy forgings to permit economical production. Closer tolerances can be maintained if the higher production costs are warranted. The tolerances given apply to aluminum forgings. For magnesium forgings, multiply the weight of the forging by 1.5 to establish the equivalent weight of an aluminum forging, and use the tolerances for this weight.

Tolerances on the over-all thickness of the forging, measured in a direction perpendicular to the forging plane, or parallel to the direction of press ram travel, are given in Table 1.

Straightness tolerance, or the contour tolerance, is inspected by means of feeler gages and a straightedge or contour templet held in contact with the surface. The tolerance used is governed by the length or width of the forging, whichever is greater, as shown in Table 2.

Mismatch of a forging is caused by misalignment of the dies, resulting in a shift of one part of the forging along the parting line from the desired position opposite the other part. Allowable mismatch tolerances are difficult to express in a table.

Table 1. Thickness Tolerances for Different Weights of Forgings

Weight of Forging, Pounds	Thickness Tolerance, Inch	
	Plus	Minus
0 to 0.25	0.032	0.010
0.25 to 1	0.032	0.015
1 to 4	0.045	0.032
4 to 17	0.062	0.032
17 to 24	0.078	0.032
24 to 50	0.093	0.032
50 to 100	0.125	0.045
100 to 250	0.187	0.062
250 and over	0.250	0.062

Table 2. Straightness Tolerances for Forgings of Various Lengths or Widths

Length or Width of Forging, Inches	Straightness Tolerance, Inch
0 to 9	1/64
9 to 18	1/32
18 to 30	3/64
30 to 45	1/16
45 to 60	3/32
60 to 80	1/8

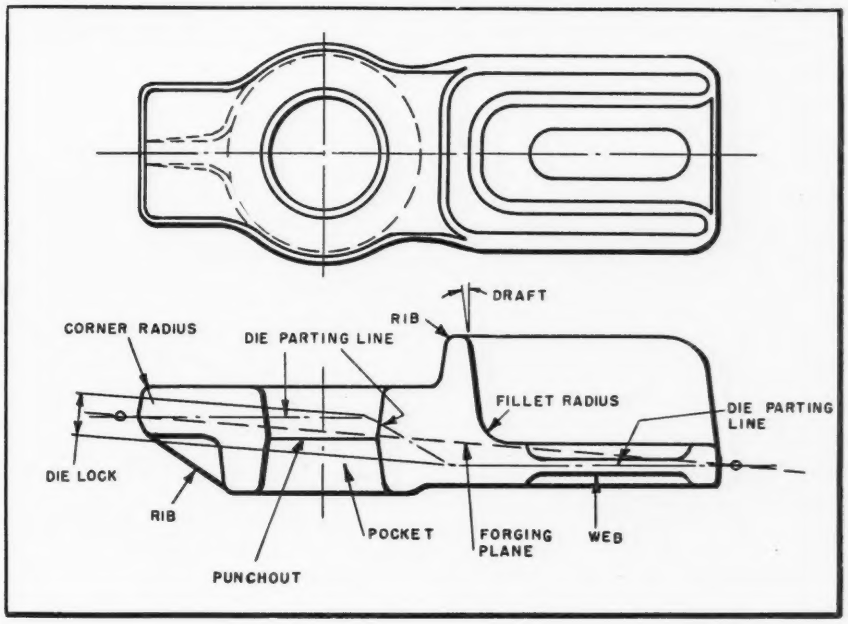


Fig. 2. Drawing of typical forging, illustrating forging terminology. For example, "die lock" is the amount one die protrudes into the other when an irregular parting line is employed

The amount of stock allowance for machining must be based on the forging tolerances employed. In general, a machining allowance of approximately 1/16 inch is sufficient for small parts. On larger parts, 1/8 inch or more may be necessary, depending on the size and design of the part.

Forging dimensions perpendicular to the parting line are affected by the thickness and straightness tolerances. To insure a complete "clean up" of the forging during machining, extreme tolerance conditions should be considered in determining the machining allowance. For example, the over-all forging thickness (perpendicular to the parting line) should equal the desired finish-machined thickness plus the minimum thickness tolerance plus the maximum straightness tolerance plus a minimum allowance for "clean up."

Forging dimensions parallel to the parting line are affected by the length, width, straightness, and mismatch tolerances. For example, the over-all length of the forging (parallel to the parting line) should equal the desired finish-machined length plus the maximum mismatch tolerance plus the minimum length and width tolerances plus the maximum straightness tolerance plus a minimum allowance for "clean up."

Points to Consider in Forging and Die Design

Higher quality forgings, increased die life, and more economical production are the direct results of properly designed forgings and forging

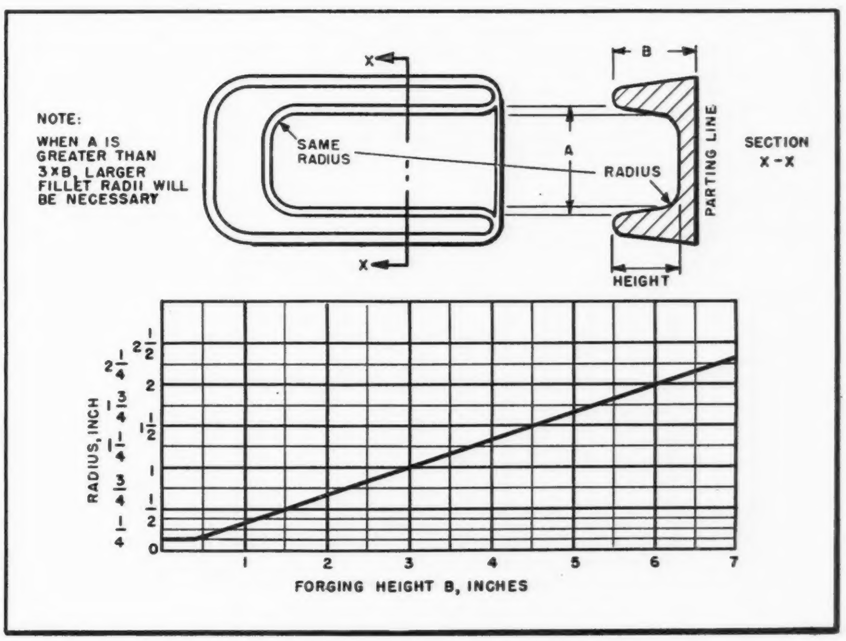


Fig. 3. Recommended fillet radii for various forging heights when the metal forming the fillets is confined by the forging die

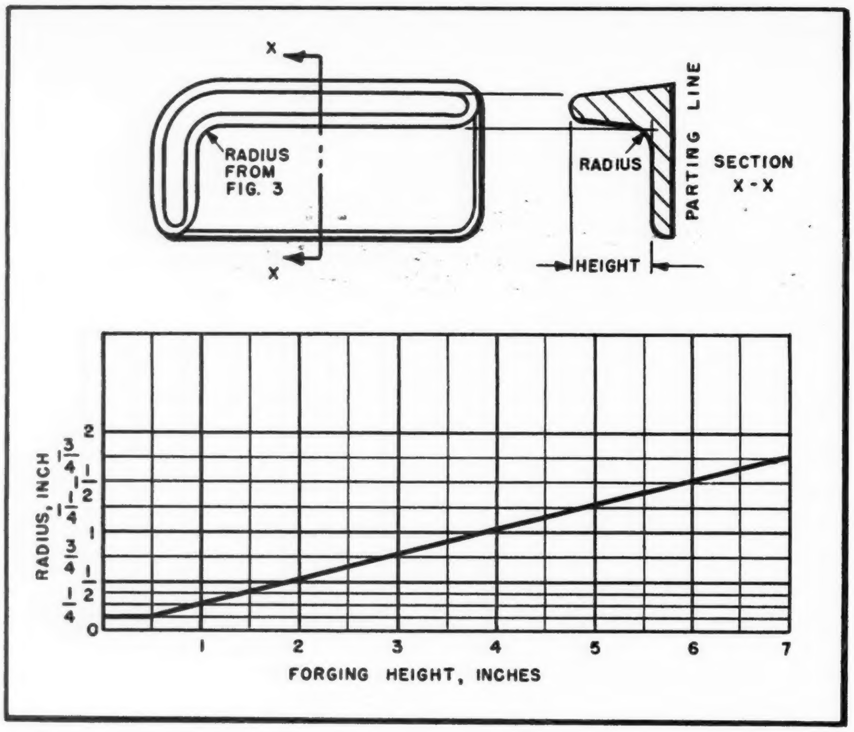
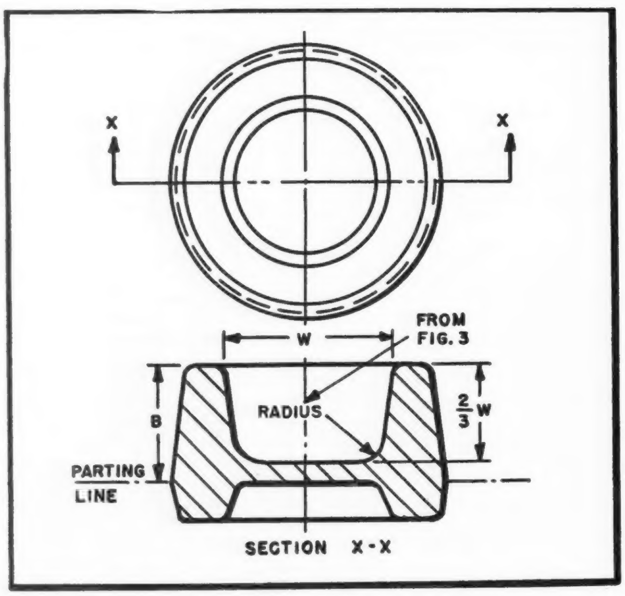


Fig. 4. When the metal is not confined by the forging die, as in forming the fillet shown in section X–X, smaller fillet radii can be employed

dies. The parting line, along which upper and lower dies separate, may be straight or irregular, depending upon the design of the forging. In general, it is preferable to have the parting line pass through the center or profile of a web. In cases where the part can be forged with a cavity in only one die, the problem is simplified, since no matching of dies is necessary.

Locked dies are those in which an irregular parting line is employed, as in the example shown in Fig. 2. The protrusion of one die into the other is called the "die lock." The forging plane is perpendicular to the direction in which the press hammer moves, and determines the position in which the part is placed in the dies.



In general, thicker webs, larger fillets and corner radii, and greater draft angles are required on light-alloy forgings than on comparable steel forgings. Most dies for light-alloy forgings made on drop-hammers, and all dies for such forgings having complex shapes or deep ribs and pockets, are provided with a standard inside and outside draft angle of 7 degrees to facilitate removal of the forging from the die. Forging dies employed on upsetting machines have a standard draft angle of 1 degree. Small, symmetrical parts can be produced in forging press dies having draft angles as small as 1/4 degree. Knock-out pins or other mechanical means of ejection are generally required in such dies to remove the part from the forging press. Draft originates from the parting line, but the draft angle is usually measured from the forging plane.

Generous Corner Radii and Fillets are Advantageous

Abrupt changes in section should be avoided whenever possible in the design of light-alloy forgings, particularly with magnesium alloys. When such changes cannot be avoided, generous corner radii and fillets should be provided on the forging. Large fillets and corner radii, even on forgings not having abrupt section changes, facilitate the flow of aluminum while it is in

Fig. 5. Depressions can be forged to a depth equal to about two-thirds the diameter of the opening. Recommended fillet radii for the bottoms of such depressions are given in Fig. 3

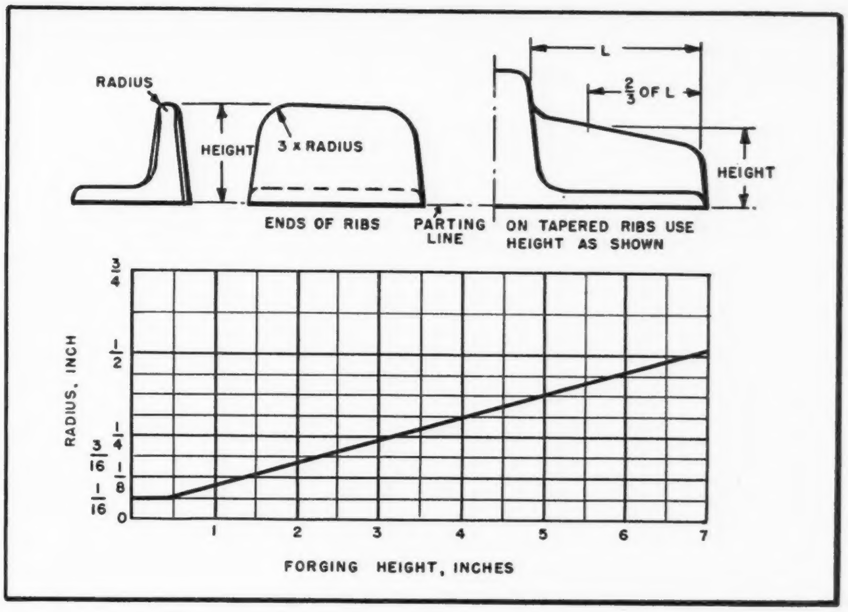


Fig. 6. Radii on the edges of ribs should not be less than those shown. Smaller radii will retard metal flow and shorten die life

the plastic state and prevent the formation of folds (cold shuts), laps, seams, or other defects. Liberal corner radii and fillets also minimize uneven shrinkage and distortion when the metal cools after forging and when it is quenched after heat-treatment. Larger fillets and corner radii are generally required on light-alloy forgings than those specified for brass or steel parts.

Cold shuts result from the plastic metal being forged together from different directions. In forging steel, which is done at relatively high temperatures, such folds are "welded" together. With aluminum and magnesium alloys, however, defects of this kind, when once formed, will not weld together. If the defect is not removed at once, before performing subsequent operations, the forging must be scrapped.

Recommended design proportions for various details of light-alloy forgings are shown in Figs. 3 to 11, inclusive. These are applicable to all aluminum and magnesium forging alloys except 75S, AM-C57S, and AM-C58S. For these three alloys, which are the most difficult to forge, the design values given should be increased by an amount proportional to the forging problem involved. Recommended fillet radii for various forging heights, when the metal forming the fillets is confined by the forging die, are shown in Fig. 3. When dimension *A* of such forgings is greater than three times the forging height *B*, larger fillet radii than those indicated should be used. When the metal forming the radii is not confined by the forging die, smaller fillet radii, as shown in Fig. 4, can be employed.

The depth of round, rectangular, or other shaped depressions should be limited to about

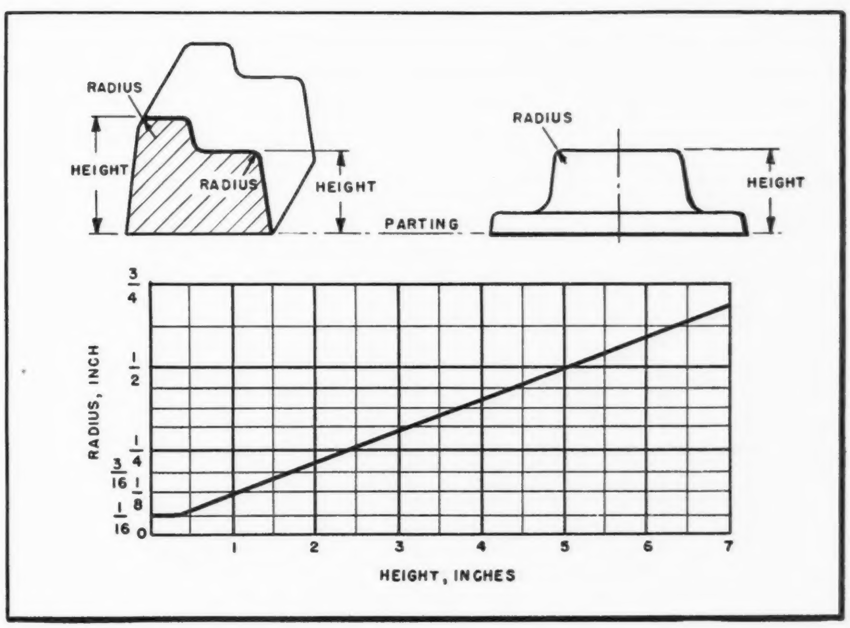


Fig. 7. Chart giving recommended edge radii for bosses or wide flanges on light-alloy forgings

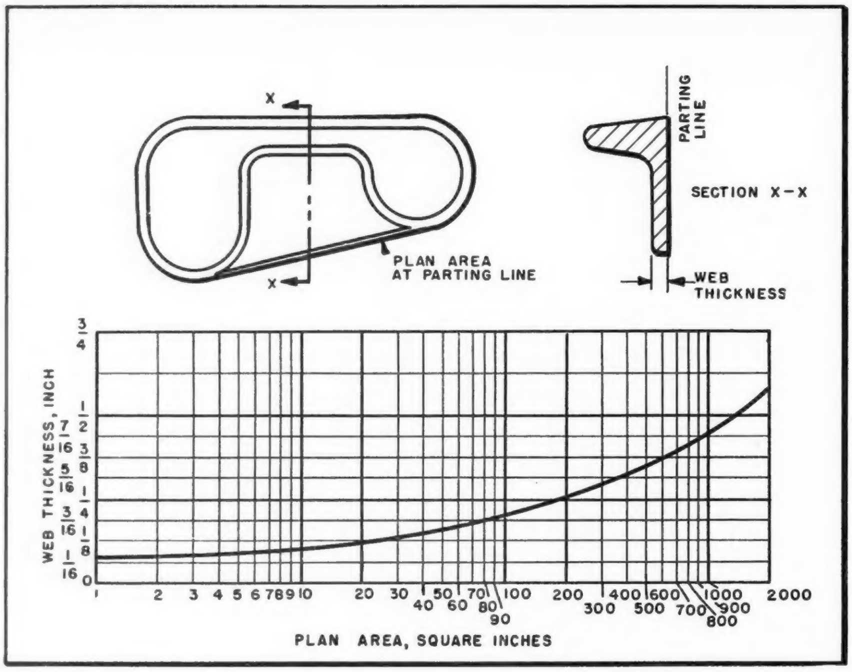


Fig. 8. Minimum web thicknesses recommended for various plan areas measured at parting line of forging

two-thirds the diameter *W* of the depression, Fig. 5, whenever possible. Fillet radii at the bottom of the depressions should approximate those given in Fig. 3, based on the forging height *B*. All corner and fillet radii on any one forging should be kept the same whenever possible to simplify die-sinking and to prevent variations that might occur in blending the radii. There are, of course, instances where blending of fillets is necessary.

Edge or corner radii should be specified as large as possible to facilitate metal flow and prolong die life. Excessive pressures are needed to fill small fillets in the die cavity when small corner radii have to be produced on the forging. It is at such points in the die that cracks or checks are most likely to occur. Minimum edge radii for ribs on various heights of forgings are shown in Fig. 6. Corner radii on the ends of the ribs should be made three times the values shown. Edge radii for bosses or wide flanges of various forging heights are given in Fig. 7.

Thin webs or ribs on light-alloy forgings cool rapidly from the forging temperature, thus requiring repeated blows or reheatings to bring them to size. Such a procedure causes excessive strain on forging dies and equipment. Dimensional tolerances are difficult to maintain on forgings of such design, because the thin web will cool and shrink faster than other portions. Thin sections are also susceptible to warping in subsequent heat-treating, requiring expensive straightening operations.

To facilitate forging, webs should be made as thick as possible. Recommended minimum web thicknesses based on the plan area at the parting line of the forging are given in Fig. 8. Ribs should be made as wide as possible, and the rib height kept as low as the design will permit. If center ribs are required to strengthen forgings, their height should not exceed one-half the height of the end ribs, as indicated in Fig. 9. It is possible to forge center ribs higher than this limit, but the forging operation is more difficult. Full

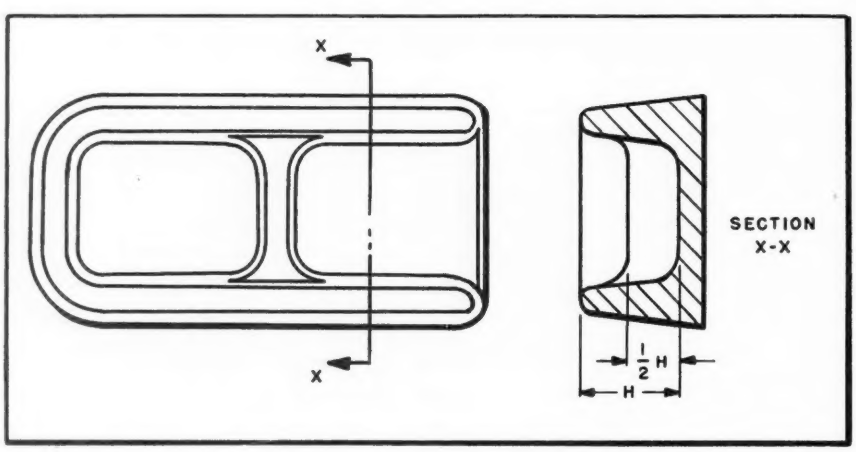
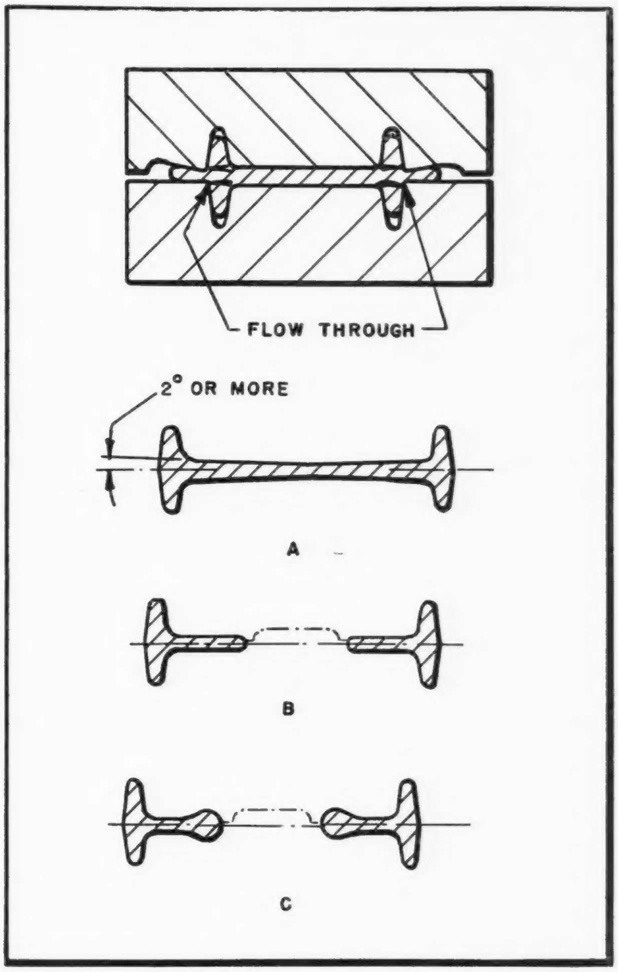


Fig. 9. Height of center ribs on a forging should not exceed one-half the height of the end ribs

Fig. 10. To prevent "flow through" defects, which may shear tapered ribs at their bases, alternate designs (A), (B), or (C) may be employed



radii should be provided on the edges of ribs whenever possible.

Progressive reduction in thickness of thin webs from base to outer edge will increase the resistance to metal flow. Deep cavities required for forging such ribs may not become filled with metal before the web is forged to size. The resistance to the flow of metal into the rib cavity may be sufficient to shear the rib section at its base, the excess metal following the path of least resistance into the gutter. This type of forging defect is known as a "flow through," as seen at the top of Fig. 10. Such defects cannot be removed, and the forging must be scrapped.

To improve the forgeability and increase the die life, three designs are commonly employed to produce ribs of the kind referred to. The three designs are tapered web *A;* web with punch-out *B;* and beaded web with punch-out *C.* Gutters for flash and excess metal are provided in the centers of forgings *B* and *C.* This material is subsequently punched from the forging.

Numerous small vee or so-called "bath-tub" type forgings are employed in aircraft structural frames. Recommendations for the various dimensions of this type of forging are given in Fig. 11. Suggested thicknesses *T* and *t* can be selected from Fig. 8, and the radius of the fillet R_1 from Fig. 4.

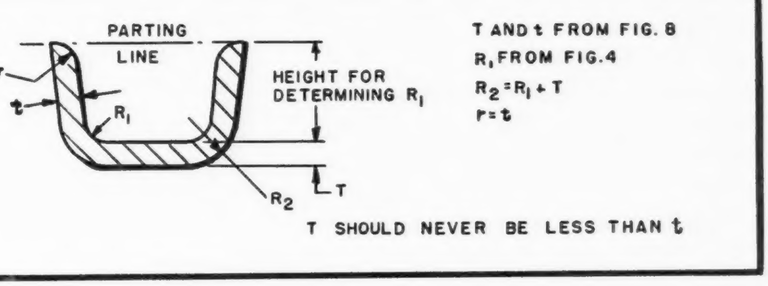
* * *

Quality Control Conference

The fourth national convention and fifth midwest conference of the American Society for Quality Control will be held in Milwaukee, Wis., on June 1 and 2. The program includes training sessions and clinics, together with actual demonstrations of quality control in operation. The demonstrations will be presented by exhibits of machines actually making pieces to which the controls will be applied. Thus the observer will see how control is assured for specific operations and how the techniques provide warning of troubles before they result in scrapped work.

The training sessions are designed to provide enough information and experience in two days to give executives and persons in supervisory capacities an understanding of the basic principles of statistical quality control and to provide technical men with the knowledge and experience to apply the methods in their own work. Latest developments of techniques, as well as new applications of known techniques, will be presented in ten clinical sesssions. Lewis D. Crusoe, vice-president of the Ford Motor Co. and general manager of the Ford Division, will discuss "What Management Expects from Quality Control" at the luncheon, on the final day.

Fig. 11. Recommended design proportions for the various dimensions of "bath-tub" forgings for aircraft structural frames



Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Hydraulic Equipment Oil for Extreme-Temperature Use

A new oil, "Gulflite Oil 5W," for hydraulic motors, pumps, and similar equipment has been placed on the market by the Gulf Oil Corporation, Pittsburgh, Pa. Although lighter in viscosity than the lightest conventional motor oil (its viscosity being 90 to 100 Saybolt universal seconds at 100 degrees F.), this oil is said to maintain its body, heavy load-carrying capacity, and non-foaming and free-flowing characteristics throughout the entire range of temperatures in which such equipment is normally operated.

The new oil is recommended for hydraulic pumps and similar precision equipment which either generates high temperatures or is used in sub-zero weather. It is compounded with selected additives which retard oxidation and increase its capacity to lubricate parts under extremely heavy loads. The manufacturer points out that the use of the oil will reduce damage resulting from cold weather starts and will minimize leakage at high temperature. 201

Copper in Paste Form Facilitates Furnace Brazing

Copper in paste form, which enables substantial savings to be made in assembling parts by furnace copper brazing, has been developed by the Metals Refining Co., 1717 Summer St., Hammond, Ind., a division of the Glidden Co., Cleveland, Ohio. This paste, called "Cubond," is said to provide a source of copper that can be applied with more speed and less waste than conventional sources such as rings, foil, slugs, and electroplate.

Guns which apply "Cubond" as an extrusion in definite quantities, depending on the trigger setting, have also been developed by the company. The guns are designed for either pneumatic or hand use. The pneumatic type can be set for automatic operation and actuated by foot-pedals, cams, or electrical controls.

The pastes are produced in two general types —one with a synthetic petroleum base, and the other with a base that does not change viscosity when changes in temperature occur. The former has good adherence to steel, and supplies copper in a fluidity equal to that of wire at brazing temperatures. Since the non-petroleum base pastes do not thin with temperature rises, there is less tendency for the material to flow away from the joint.

By incorporating a small amount of finely divided iron powder in the copper, a cementing material can be obtained that is useful in many cases where loose fits for expansion purposes are required. The cementing action holds the copper in place, fills cracks or loose joints, and provides fillets of the desired size. 202

Cold-Drawing Compound that Gives Brighter Finish

E. F. Houghton & Co., Philadelphia 33, Pa., has announced a new drawing compound, known as "Houghto-Draw 357," for use in the cold-drawing of hot- or cold-rolled bars or rods. This product is a heavy paste containing high melting point waxes and fats with a colloidal pigment. It has exceptionally good adhesive properties, and is applied by immersing the work in a tank containing a water solution of the compound. Bars drawn with it are claimed to have a brighter finish and smoother surface than those drawn with the aid of a lime coating. 203

Protective Maintenance Coating that is Rust- and Corrosion-Resistant

A rust-inhibitive protective coating called "Kem-Ban" has been brought out by Ace Laboratories, 1614-18 Coutant Ave., Lakewood 7, Ohio. This multi-purpose paint provides both rust inhibiting action and resistance to acids, alkalies, chemical fumes, moisture, salts, and alcohols. The compound can be applied by spray, dip, or brush methods, and dries in from twenty to thirty minutes. The resultant coating is a fire-retardant film of uniform thickness and high hardness that will not check, peel, or crack.

"Kem-Ban" is said to adhere tenaciously to all metal surfaces, including galvanized materials,

clad metals, and even polished and stainless steels. It is equally applicable to wood, linoleum, and composition flooring, having high resistance to scuffing, abrasion, and other marring. Another use for which it is suitable is as a sealing compound for hot plaster, stucco, cement, concrete, and other alkaline materials. 204

New Readily Compacted Stainless Steel Powders

Stainless steel powders that can be pressed into intricate shapes have been developed by the American Electro Metal Corporation, Yonkers, N. Y. The strength of the pressed compacts prior to sintering has been increased, as compared with other stainless steel powders, while the chemical analysis of the new powders corresponds to that of standard chromium and chrome-nickel steels.

Parts produced by pressing and sintering the powders are said to exhibit the high mechanical strength and corrosion resistance characteristic of these compositions. 205

Glass Filament Packaging Tape with High Tensile Strength

A glass filament pressure-sensitive adhesive tape, called Scotch brand filament tape No. 890, is now being made by Minnesota Mining & Mfg. Co., St. Paul, Minn. The new tape has greatly increased tensile strength, and is especially designed for heavy-duty packaging, such as banding hundreds of pounds of steel pipes, tubes, and coils. It is also useful for strapping fiber-board cartons and similar jobs. Tape No. 890 has an acetate film backing and glass filaments permanently embedded in a resilient, shock-proof, rubber adhesive.

The new tape has a tensile strength of 500 pounds per inch of width, compared with 175 pounds for the two filament tapes previously announced by the company. Its shock resistance is twice as great as that of the earlier tapes, and its tear resistance is said to be greater than can be measured on the A.S.T.M. approved Elmendorf tear tester.

The tape is applied by being wrapped by hand around a load and then back on itself. It sticks immediately on contact. 206

Silicone Coating for Weather-Exposed Surfaces

Objects exposed to the weather and to temperatures up to 750 degrees F., can be protected by a new silicone coating aluminum introduced by the Dampney Co. of America, Hyde Park, Boston 36, Mass. This product utilizes the unique characteristics of silicone resins, which combine high inertness and heat stability with unusual water repellence and low moisture absorption to provide heat- and weather-resistant surfacing of exceptional durability.

Dampney silicone coating is formulated to withstand either continuous exposure to heat or intermittent heating and chilling, as well as all conditions of weather exposure, in addition to attack by chemical fumes. It is therefore well suited for out-of-doors service in industrially contaminated atmospheres, as well as for exposure to the atmosphere under shelter, and is recommended for application to such equipment as stacks, furnaces, boilers, heaters, ovens, steam lines, gas burners, and exhaust mufflers.....207

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on these pages, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning name of material as described in MAY, 1950, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on blank below. Detach and mail within three months of the date of this issue to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

NAME...POSITION OR TITLE..................................

[This service is for those in charge of shop and engineering work in manufacturing plants.]

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Simple Method Cylinder Sleeve

The Cost of Machining Cast-Iron Cylinder Sleeves has been Reduced Substantially, Rejections have been Minimized, and the Quality of the Work Greatly Improved by Simply Turning and Facing the Castings prior to Boring — A Reversal of Conventional Practice

By A. A. HERZBERG, Factory Manager
Waukesha Motor Co., Waukesha, Wis.

Fig. 1. Cast-iron cylinder sleeves are held by their rough bores while rough-facing, turning, and forming a clearance bevel on one end

IN machining cylinder sleeves by conventional methods, the boring operation is generally performed before turning the outside, the work being chucked on the periphery of the casting. By the simple expedient of reversing this procedure and turning the outside of the sleeve prior to boring, substantial reductions in the cost of machining have been effected at the Waukesha Motor Co., Waukesha, Wis.

On the smallest size sleeve produced, the machining cost per part has been reduced more than 50 per cent. Since the stresses and distortion normally resulting from chucking have been minimized, scrap and parts that require reworking have been practically eliminated. In addition, closer tolerances can be maintained and a higher quality product is the result.

The procedure, with the new method, is as follows: Cylinder sleeves, produced by both centrifugal and sand casting, are stacked on pallets for transfer to the machining department. The castings are rough faced and turned and a clearance bevel is formed on one end on Sundstrand automatic lathes, as shown in Fig. 1. Air-operated, expanding type arbors are provided on both the headstock and tailstock to grip the rough bore of the casting.

Approximately 1/8 inch of stock is removed from the various surfaces of the cylinder sleeve in this operation. Four carbide-tipped tools are mounted on the front tool-slide for turning and four on the rear slide for facing both ends and forming the clearance bevel on the casting. The work is rotated at 132 R.P.M., corresponding to a surface speed of 168 feet per minute, while the tools are fed at the rate of 0.023 inch per revolution. An average production of forty-five cylinder sleeves per hour is obtained, depending upon the size of the sleeve. Coolant is not required for the cutting tools, but the tailstock is kept flooded with coolant to prevent dirt and chips from entering the bearings.

For the boring operation, the cylinder sleeve is located by the flanged end and clamped on the small-diameter end, thus insuring squareness of the bore with the faces and concentricity of the bore with the flange periphery. The cylinder sleeves are rough-bored, six at a time, on the Ex-Cell-O multiple-spindle boring machine seen in Fig. 2. A similar machine is employed for finish-boring. The sleeves are automatically clamped and unclamped by means of hydraulically operated fixtures mounted on the machines. The top half of the fixture is mounted on the vertical head of the machine, and is raised with the boring-bars at the completion of the cycle to facilitate unloading and reloading.

A single-point, carbide-tipped tool is mounted in each boring-bar. About 1/8 inch of stock is removed per side in rough-boring, and 0.030 inch of stock from the bore diameter in finishing. A cutting speed of 230 surface feet per minute is employed, and the tools are fed at the rate of 0.015 inch per revolution for roughing and 0.010

# of Reducing Machining Costs

inch per revolution for finishing. The bored sleeves are automatically unclamped before the boring spindles are raised, thus minimizing the formation of tool marks when the tools are retracted through the sleeves.

Bore size is maintained within ± 0.001 inch, and an average production of ninety sleeves per hour is obtained. Coolant is employed during rough-boring only, the primary purpose being to keep the sleeves cool and to flush the chips away.

Cylinder-sleeve bores are finished by means of the honing operation seen in Fig. 3. Approximately 0.003 inch of stock is removed in this operation, and the bore size is held to 0.0005 inch total tolerance. A fixture similar to that employed for boring, which locates the work by the flanged end of the sleeve and clamps the small-diameter end, is mounted on the table of a honing machine made by the Barnes Drill Co.

The honing tool, containing a set of six 150-grit abrasive sticks, is automatically expanded a pre-set amount per stroke. Reciprocation and rotation of the tool are automatically stopped at the end of a predetermined time cycle. The tool is rotated at the rate of 225 surface feet per minute, and reciprocated at 60 feet per minute. A coolant of sulphurized mineral-base oil mixed with kerosene is employed. With this set-up, forty-five cylinder sleeves are honed per hour on each machine.

Final operations on the cylinder sleeves consist of finish-turning, chamfering, grooving, and facing. These are performed on Sundstrand automatic lathes with the set-up seen in Fig. 4. The sleeves are accurately located and clamped by means of two sets of bronze blocks, mounted on an expanding arbor, which are inserted in the honed bores. A work speed of 247 surface feet per minute (or 195 R.P.M.) is employed, and the tools are fed at 0.008 inch per revolution. The outside diameter of the sleeve flange is maintained within ± 0.0005 inch, while a tolerance of ± 0.001 inch is permitted on the other surfaces machined in this operation.

Three carbide-tipped tools are mounted on the front cross-slide, the tool nearest the headstock being employed to finish-turn the ring-groove

Fig. 2. Multiple-spindle precision boring machines are used to rough-bore cylinder sleeves, six at a time, after which they are finish-bored on similar machines

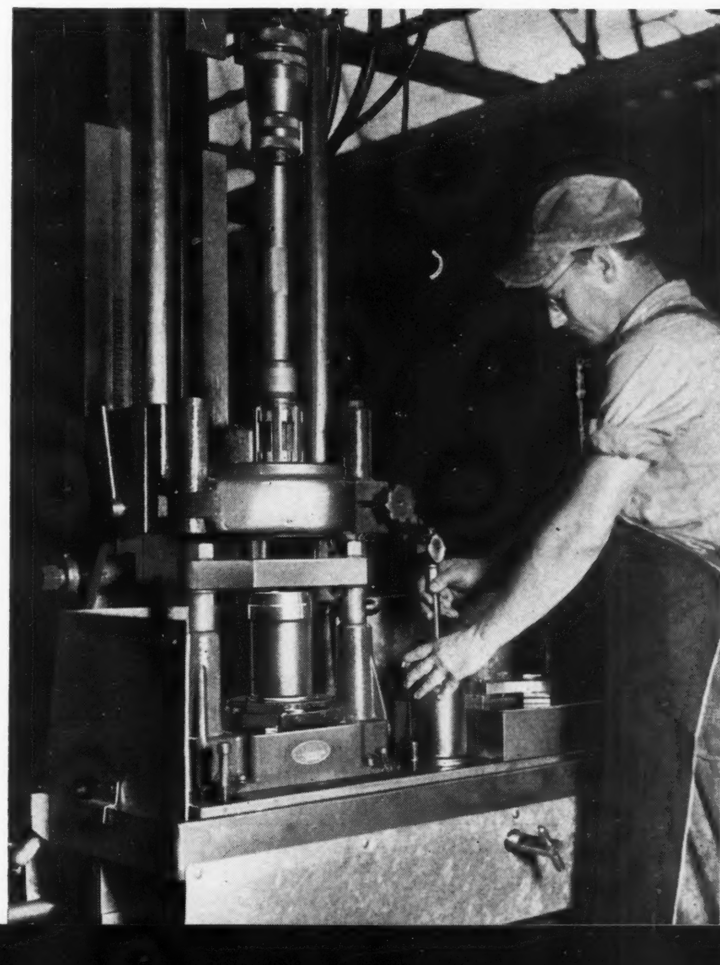


Fig. 3. About 0.003 inch of stock is removed from the cylinder-sleeve bore in this honing operation. A tolerance of 0.0005 inch is maintained

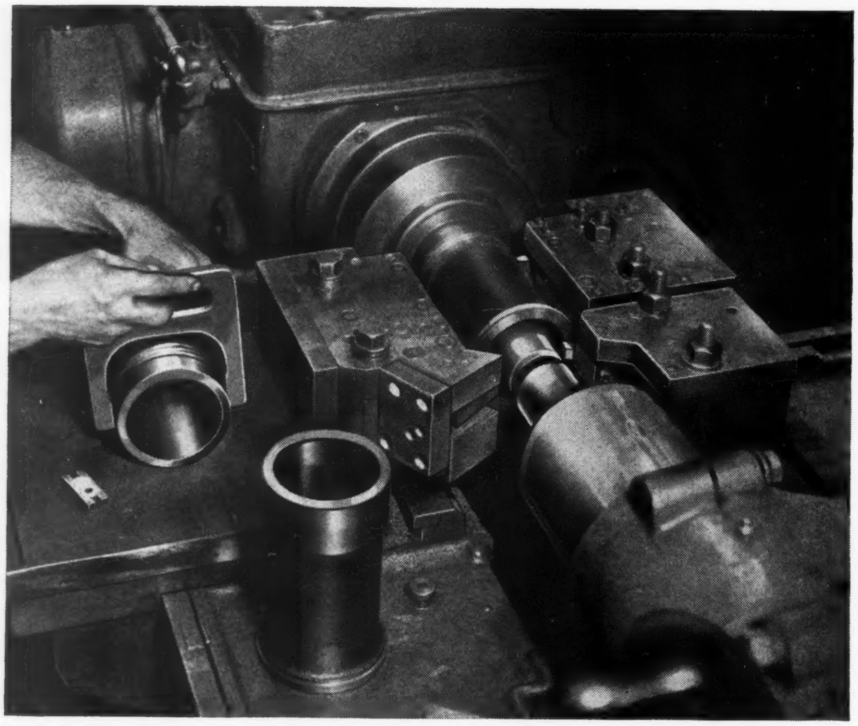


Fig. 4. Set-up employed for finish-turning, chamfering, grooving, and facing cylinder sleeves. A production of forty-five per hour is obtained for the sleeve size shown

lands; the center tool to finish-turn the flange diameter; and the third tool to chamfer the bore.

The rear cross-slide is also equipped with three carbide-tipped tools. Ring grooves on the periphery of the cylinder sleeve are formed by the tool mounted at the left of the rear cross-slide, and the inside surface of the flange is faced and chamfered by the centrally located tool. The right-hand tool, which has a roller mounted on it that contacts a cam-bar, finish-faces the outside surface of the flange to a 0.004-inch taper. The cam becomes inoperative at the completion of the cutting cycle, so that no tool marks are made on the flange face when the rear cross-slide is retracted.

* * *

Non-Destructive Testing Symposium at A.S.T.M. Convention

A symposium to acquaint engineers and management with non-destructive testing and its advantages will be held on June 27 at Atlantic City during the annual meeting of the American Society for Testing Materials. The theme of the one-day conference will be "The Role of Non-Destructive Testing in the Economics of Production." Papers by authorities in the field will survey the wide range of applications of all the non-destructive testing and inspection methods, and will show how proper use of them can reduce production costs and improve product quality. The testing methods to be covered include radiography, ultrasonics, magnetic-particle and liquid-penetrant inspection, and magnetic analysis.

Atomic Power Plants Present Special Material Problems

Special problems that confront the atomic engineer were discussed at a recent meeting of the American Institute of Electrical Engineers by Harry E. Stevens, a staff member of the Knolls Atomic Power Laboratory which the General Electric Research Laboratory operates for the Atomic Energy Commission.

He pointed out the adverse effect on atomic power plant structures of the high-energy particles and radiations emitted from the nuclear reactor—the furnace of an atomic power plant. These radiations are able to penetrate considerable thicknesses of any material, and thus may change the arrangement of the atoms of which a structure is made, materially altering its physical properties. Hence, a structural material that is satisfactory for ordinary engineering uses might be made unfit for prolonged operation in an atomic power plant.

Another deleterious effect may result. Atomic particles called "neutrons," which are produced in large numbers in the reactor, are responsible for maintaining the chain reaction by which atomic energy is released. The control rods required to keep the reactor from "running away" soak up these neutrons; however, if much of the rest of the structure acts as a neutron "blotter," the supply of neutrons will be depleted and the power reduced. Such considerations force the engineer to consider new structural materials, which, in turn, raise a fresh array of procurement problems.

Tool Engineering Ideas

Tools and Fixtures of Unusual Design, and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

Milling Fixture Designed for Unsymmetrical Castings

By ROBERT MAWSON, Providence, R. I.

The fixture illustrated in Fig. 1 was designed to hold the unsymmetrical shaped cast-iron clutch lever shown in Fig. 2 while milling the seats indicated at *X*. An outstanding feature of the fixture is the positive locating and quick acting clamping devices provided. Prior to being milled, the lever is faced to length and the ends drilled and reamed as shown.

The base *A* of the milling fixture is cast iron and has a groove in the bottom in which are fastened steel keys *B* that fit the slots in the milling machine table. A cast-iron sub-base *C* rests on finished pads on the main base. The casehardened stud *D* engages a tapped hole in sub-base *C* and is a sliding fit in the main base, providing a pivot about which the sub-base may be swung into and out of the machining position. This permits the fixture to be loaded and unloaded without stopping the milling machine.

A pin *E* is driven into a drilled and reamed hole in a boss on the sub-base to provide a point against which the right-hand arm of the clutch lever can be located and held. The overhanging section of this boss contains a knurled-head screw *F* having a pointed end which engages the arm to secure it against pin *E*. A similar boss at the opposite end of the fixture carries a pin *H*, in alignment with pin *E*, which serves as a locating point for the other arm on the clutch lever. A knurled-head screw *J* secures this arm against pin *H*.

In another boss on the sub-base there is a shouldered locating pin *G* which is a sliding fit

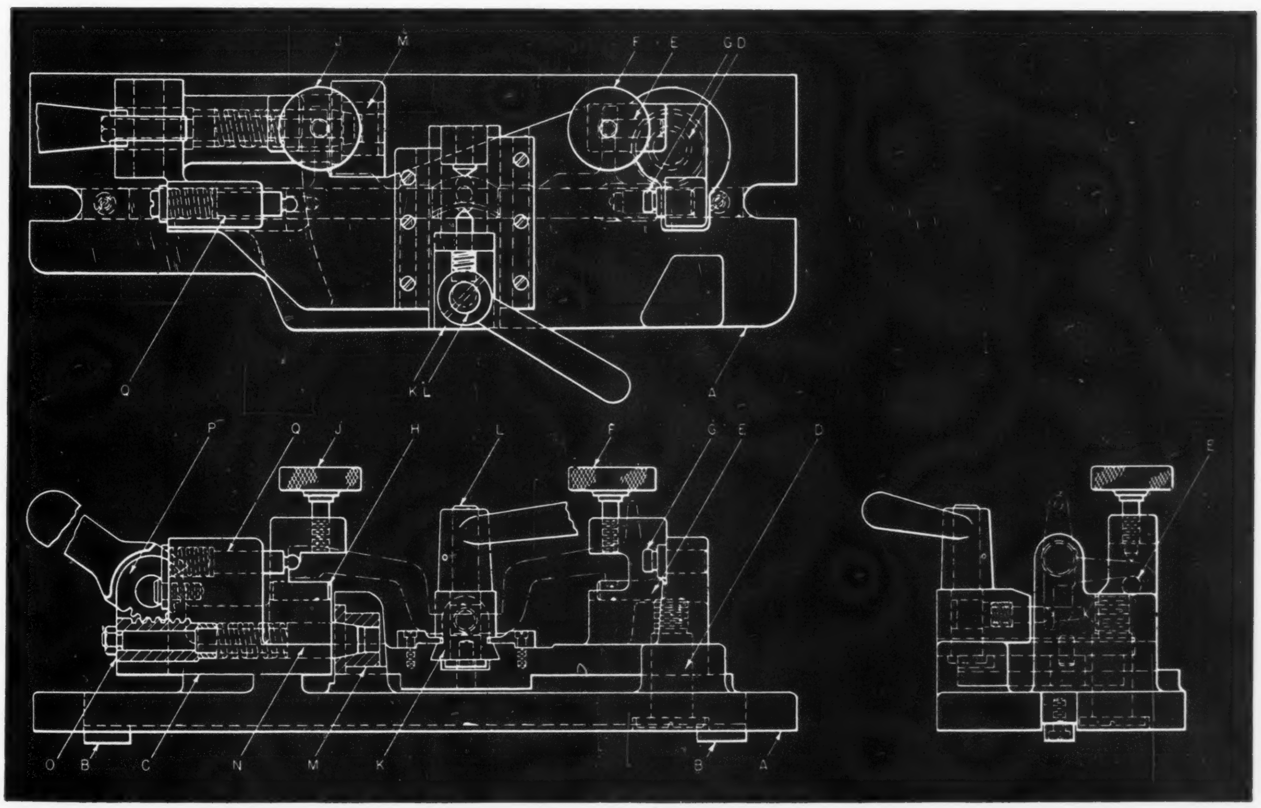


Fig. 1. Milling fixture with positive locating members and quick-acting clamping devices designed for use in milling an unsymmetrical casting

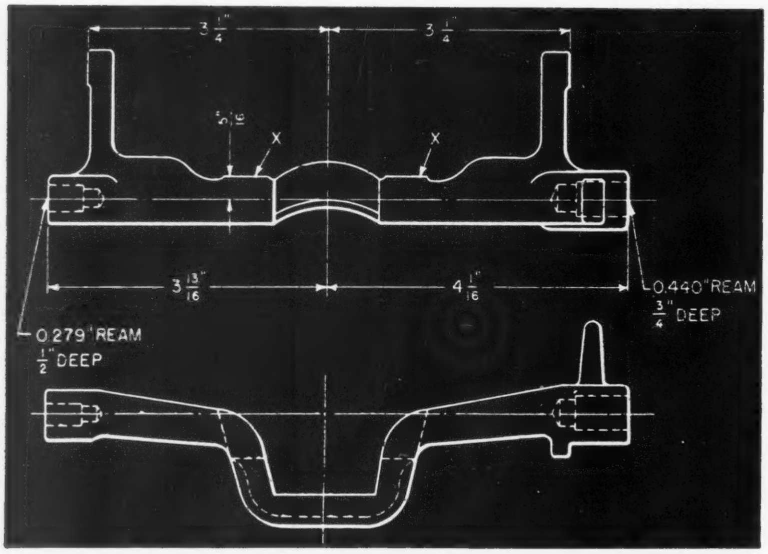


Fig. 2. Cast-iron clutch lever milled in fixture shown in Fig. 1

in the 0.440-inch diameter reamed hole in the right-hand arm of the lever. Opposite this pin and in alignment with it is a hardened and ground locating pin *Q* with a ball-shaped end which is a sliding fit in the 0.279-inch diameter reamed hole in the other arm. This pin is spring-mounted to permit retraction when loading or unloading the work.

A casehardened dovetail sliding block *K* fits beveled ways in the sub-base. The sliding block, held down by gibs on each side, has a projecting pin in it which engages an elongated slot in the sub-base, thus guiding the movement of the block along its ways in accordance with variations in the shape of the work-piece. The work is supported at a point where the surface is irregular by two hardened and ground locating pins with pointed ends in block *K*. One of these pins, at the rear of the block, is fixed, while the other, at the front, is spring-loaded. The spring-loaded pin is brought into contact with the work, to hold it securely against the fixed pin, by rotating an eccentric shaft *L* with the handle attached to it.

To provide a quick means of locking and unlocking the sub-base after it has been pivoted on the main base, a pinion *P*, to which is attached a handle, actuates a rack *O*. The rack is a hollow sleeve in a boss on the sub-base and has a shaft *N* with a tapered end running through the bore of the sleeve which engages a tapered bushing *M* in a boss on the main base. A spring, located against the inner end of the sleeve, maintains pressure on a shoulder on the aligning shaft *N*. By turning the pinion 30 degrees in a clockwise direction, the shaft is pulled out of the bushing *M* and clear of the boss in which the bushing is located. The sub-base is then free to pivot for loading the fixture.

In operation, the fixture is secured to a milling machine table with two T-bolts passing through openings at each end. Pinion *P* is turned to release the sub-base for pivoting, after which a work-piece is loaded in place. This is done by locating one end of the work on pin *G* and retracting pin *Q* to permit entry of the other end of the work, after which screws *F* and *J* are tightened to clamp the work against pins *E* and *H*. The eccentric shaft *L* is then rotated to hold the clutch lever between the points of the fixed and sliding pins in block *K*. This completes the locating and clamping of the work-piece in the sub-base of the fixture.

In order to bring the work-piece into the machining position, the sub-base is pivoted on pin *D*, and pinion *P* is moved to engage shaft *N* with bushing *M*. It will be readily understood that the use of this fixture has reduced unproductive time on the job described to a minimum.

Simple Compensating Set-Up for Milling Cams

By JAMES B. LINDSAY, Millburn, N. J.

Cams are often calculated and machined on the assumption that the follower will move on a straight line, even when the follower roll is to be mounted at the end or in the middle of a pivoting lever, such as a bellcrank or a rocker arm. When mounted in this manner, however, the roller moves along the arc of a circle having a radius equal to the distance from the center of the roller to the pivot center.

A cam follower that pivots in this way requires a different curve on the cam rise than on the fall if the arm motion is to be exactly according to the calculated design. The use of a follower roll mounted on a pivoting arm with a cam machined for a straight-line follower may disturb the timing or motion of related mechanisms in a machine.

To obtain an accurate cam movement in cases of this kind without making complex calculations or using a special compensating cutter-head on the cam milling machine, the simple set-up illustrated in Fig. 1 can be used on an ordinary horizontal milling machine. An arm *A* is rigidly mounted to the column of the machine in such a way that it does not extend past the machine

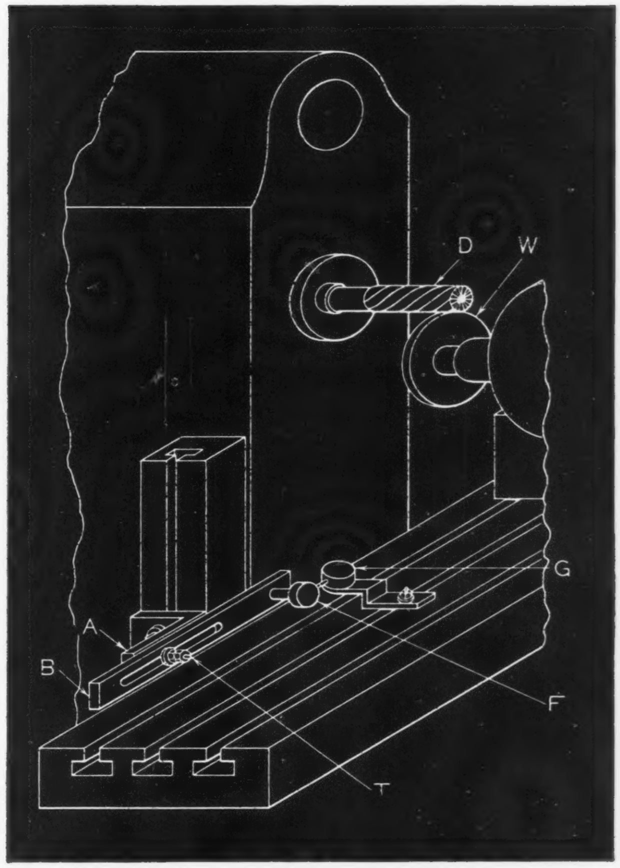


Fig. 1. With this set-up, straight-line calculations may be used to mill a cam correctly when it is to operate with a swinging follower. The set-up compensates for the arc of the follower roll

table or otherwise interfere with the table movement. A pivot-pin *P*, Fig. 3, is a press fit in arm *A* and passes through a slot in a second arm *B*. A shoulder bearing *S* fits over pivot-pin *P* and is engaged by a nut *N* which locks arm *B* in position. The arm, bearing, and nut are held in place on pin *P* by collar *C* which is fastened to the pivot-pin by a set-screw.

Arm *B* thus provides an adjustable pivoting member on which is carried a roller *F*, Fig. 1. The roller must be the same diameter as the roller that will subsequently be used on the machined cam, or the actual roller may be used. In any case, it must turn freely and must rest on a flat section of the machine table. An indicator *G* is mounted on the table so that the pointer rests against the center of the roller. A pilot *T*, at the end of the pivot-pin *P*, is pointed to facilitate finding the center when making scale measurements in setting up a job. The body of the pilot may be employed for the same purpose when using indicators or depth micrometers for more precise set-ups.

The procedure for cam milling with this arrangement is the same as that used for ordinary end-milling operations. The cam blank *W* is mounted on an arbor in a dividing head with its axis parallel to the machine spindle. After centering the blank with the spindle, the table is lowered until the blank is so located that the cutter just touches its top edge. Having been previously turned to have a radius equal to the highest rise of the cam, the blank serves as a starting place for cutting the rises. It is assumed that the profile of the cam is to be step-milled and the scallops thus produced are to be filed after milling.

The cutter *D* used in this operation should be of the same diameter as the follower roll, and the blank should be moved into the end of the cutter at each step. In this way, a mistake in the machine setting can be detected before the blank is ruined.

The cam drawing should have three dimensions not ordinarily given. These dimensions are shown in Fig. 2. They are the length of the follower arm radius *R*, the distance the roller center is above or below the pivot center *Y* or *Z*

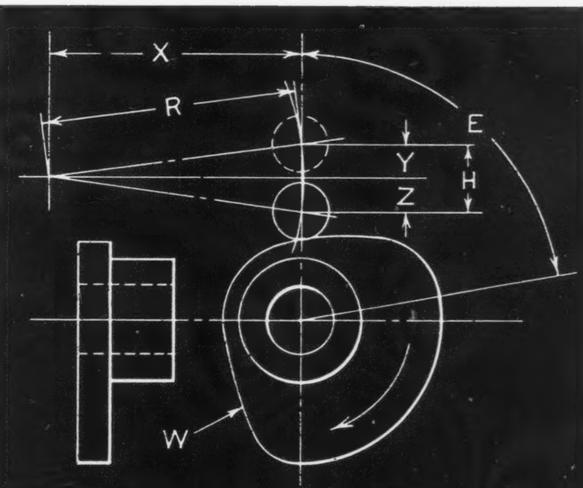


FIG. 2

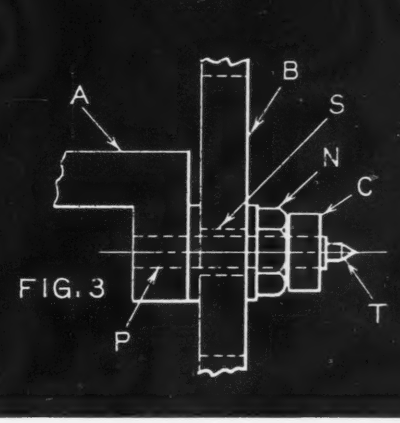


FIG. 3

Fig. 2. In using the compensating set-up shown in Fig. 1, three dimensions (R), (X), and (Y) or (Z) are required on cam drawings, in addition to those ordinarily given. Fig. 3. Details of pivoting member which provides compensation for cam milling

at the start of travel and also at the finish of the stroke, and the distance X from the center of the roller to the center of the follower-arm pivot.

The adjustable pivoting arm B, Fig. 1, is set to the same length as the follower arm radius R, and arm A on the column of the milling machine is moved up or down to set dimension Z or Y. At this stage, arm B is at the same angle as that which the actual follower arm will be with the horizontal center line of the mechanism in which the cam is to be used. The indicator is then set to read zero. The only requirement of this indicator is that its range must equal or exceed the amount the follower roll deviates from a straight line as it moves through the rise of the arc described by the follower arm.

With the cam blank axis parallel to the machine spindle, centered with it, and below its center a distance equal to the radius of the blank plus the radius of the end-mill; arm B set to dimension R, and to dimension Z or Y; the indicator set to zero; the roller free to turn and arm B swinging freely, the first cut can be made.

The blank is then moved from under the cutter and the table raised the amount required for the cut. This changes the zero setting of the indicator, and it should be reset before proceeding with the cut. Each time the table is raised for a new cut, it is moved transversely until the indicator reads zero before making the cut. This procedure is followed throughout the milling of the entire fall and rise of the cam.

By this simple process, arm B provides accurate compensation for the motion of the actual follower roll, since it travels in the same path as the follower will take. Returning the indicator to zero before each cut produces a setting for machining the cam in accordance with this motion. It should be noted at this point that arm B must start and finish in the same position as the actual follower arm. If necessary, arm B can be reversed from the position shown in Fig. 1. A feature of the device is that it works equally well for offset cam followers as for central followers, such as are shown in Fig. 2.

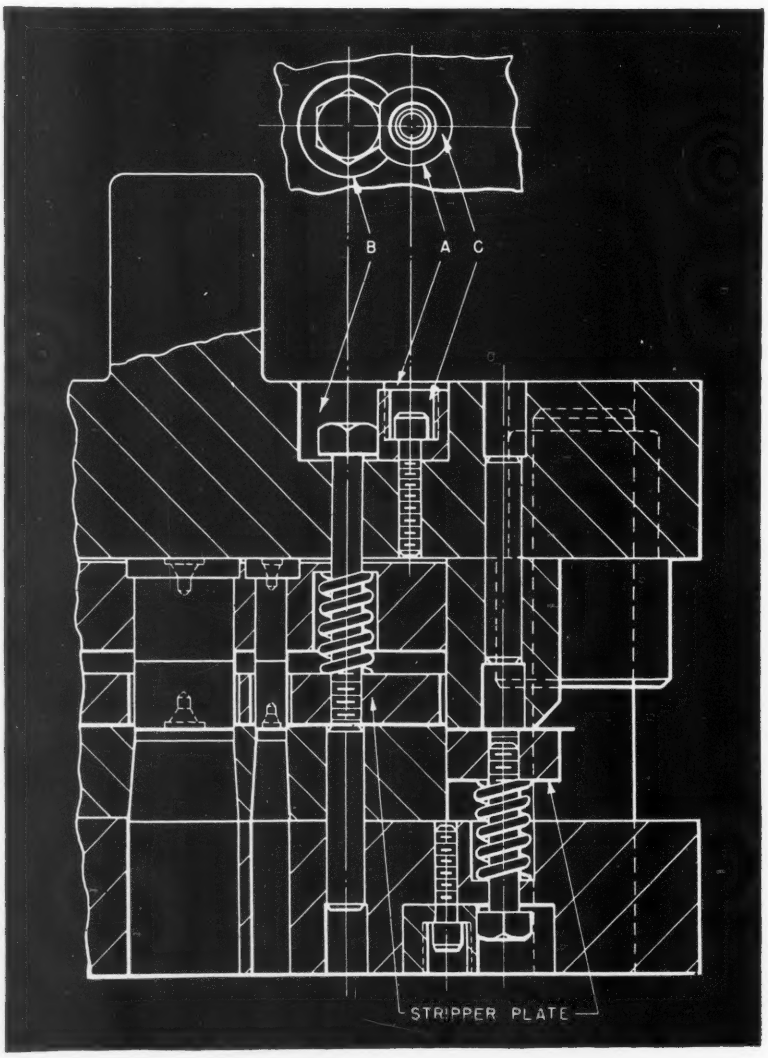
Certain precautions must be taken in using this fixture. For example, the clamps on the ways of the machine should be tightened so that they are snug but still permit movement. Table backlash should be kept in one direction, since the side thrust of the cutter changes with the rise and fall of the cam. The roller F must rest firmly on the table at all times; in some cases, it may be advisable to put a flat plate on the table under the roller to give more flat surface for the roller F to rest on and provide sufficient mounting height for the indicator above the table.

Stripper-Bolt Arrangement that Simplifies Adjustment of Stripper Plate

By L. C. FRIDDLE, Los Angeles, Calif.

The accompanying illustration shows a stripper-bolt arrangement that can be easily and positively adjusted for length when it is desired to change the position of a stripper plate relative to the face of a punch or die.

A lock-bolt hole A is drilled in the die-shoe with a jig to maintain the correct center distance in relation to



Stripper-bolt arrangement that facilitates adjusting stripper plate relative to the face of a punch or die

a cap-screw hole *B* which is produced with a piloted drill. A socket-head cap-screw holds the locking collar *C* in the die set. The collar has a flat side which engages one of the flats of a hexagon-head cap-screw that is assembled with the stripper plate, thus preventing the cap-screw from turning. A tapped hole in the locking collar facilitates removal when the cap-screw is to be turned for length adjustments. The arrangement described can be adapted for different size bolts by making the hole sizes and center distances to suit.

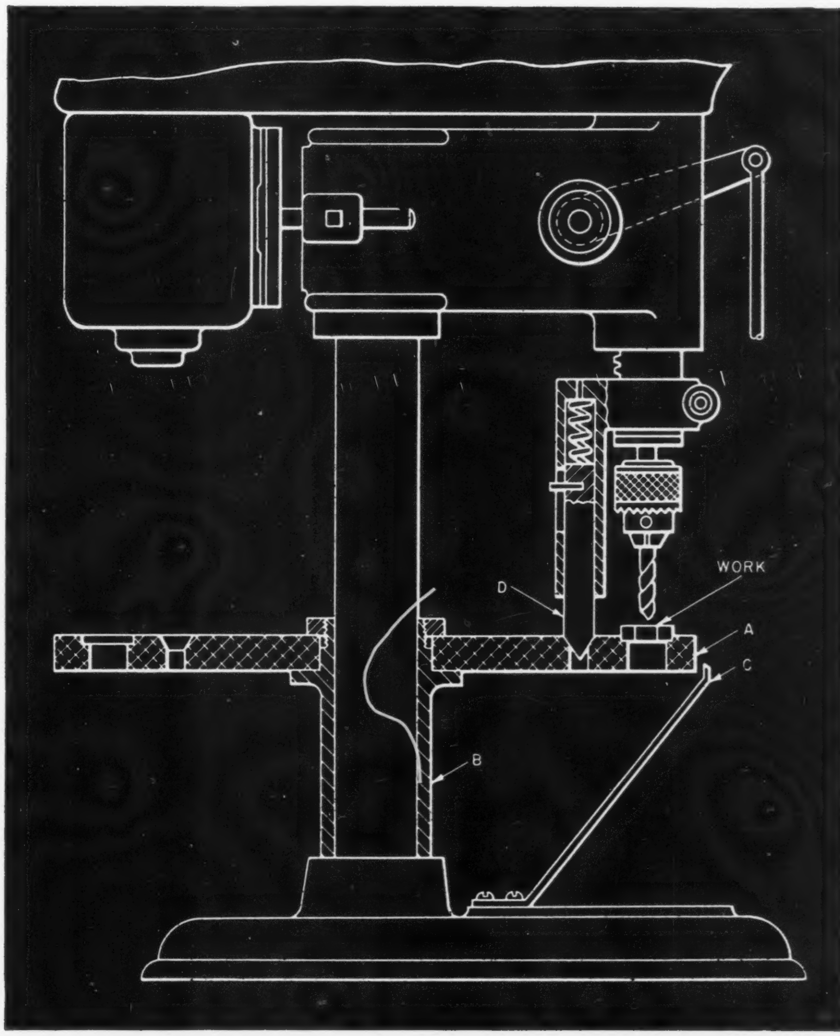
Semi-Automatic Set-Up for Simple High-Production Drilling Operations

By EDWIN MOSTHAF, Industrial Consultant
Huntington, W. Va.

A standard bench type drill press was modified as shown in the accompanying illustration to facilitate the drilling of several hundred thousand small brass washers. Although the unit is hand operated, considerable time and tool cost were saved by this arrangement, as compared with loading each washer separately into a drill jig.

A circular aluminum indexing table *A* containing nests for the hexagon-shaped washers is mounted on a seamless steel tubing support *B*. The support is threaded at one end for a nut that clamps the table to a flange on the tubing. The opposite end of the support rests on a boss of the drill press main-base casting, which acts as a bearing surface. A good bearing support on the inside diameter is provided by the drill press post, about which the table rotates.

The table is indexed by hand, a pointed strip of metal *C* indicating approximately the right position for centering the work under the drill. A positioning plunger *D* attached to the press ram engages pilot-holes aligned with each nest to center the table accurately before the drill enters the work. By actuating the drill head with a foot-lever, the operator is enabled to use both hands for loading and indexing.



Indexing table on standard bench type drill press permits high-production drilling of simple parts

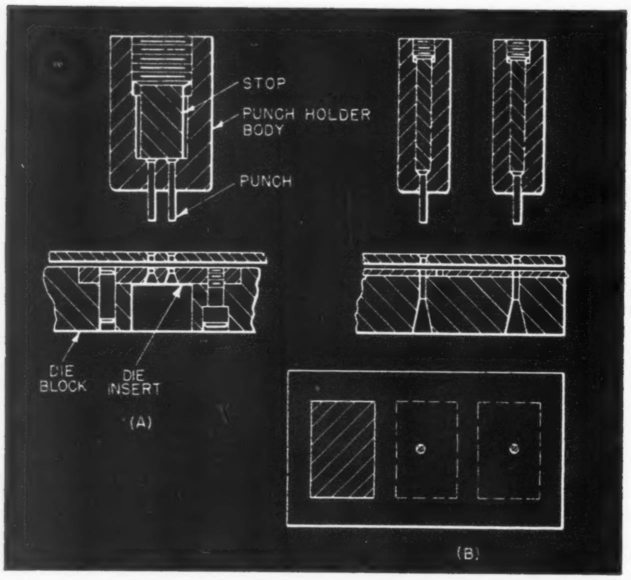
This unit can easily be converted into an automatic drilling machine for simple drilling jobs by adding a power-driven indexing arrangement and a cam-operated spindle feed.

Design of Punches and Dies for Perforating Closely Spaced Holes

By FEDERICO STRASSER, Santiago, Chile

In designing punches and dies for producing small, closely spaced holes in a part, great care must be taken to avoid weakness of construction.

Where several holes in a part are to be pierced by means of a single die, it is generally good practice to use a die insert of the type shown at *A* in the illustration (see page 194). This has



Fundamental principles of die construction employed to avoid weaknesses resulting from closely spaced holes

the advantage of being easy to machine and heat-treat, and is economical to replace when necessary. The punch-holder illustrated provides for the use of standard hardened and ground drill blanks, which have the same advantages.

Sometimes a follow-die having two or more stations can be employed for producing blanks that require closely spaced holes. A die of this type is shown at *B*, where it can be seen that the piercing operation is performed at two stations, and the blank produced at the third.

Producing Square Tool-Bit Holes in Boring-Bars

By ROGER ISETTS, Kenosha, Wis.

In shops not equipped with broaching equipment, the tedious hand filing required to produce square tool-bit holes in boring-bars can be eliminated by the method here illustrated. Slot *A* is milled in one end of boring-bar *B* at right angles to the center line of the bar and to a depth equal to the thickness of the tool plus about 0.002 inch for clearance.

A round cap *C*, cut from cold-rolled steel bar stock, is drilled and tapped at the center to receive a headless set-screw *D*, which holds the tool bit *E* securely in place. Four smaller holes are drilled and counterbored to accommodate socket-head cap-screws *F*, which clamp the cap to the end of the bar.

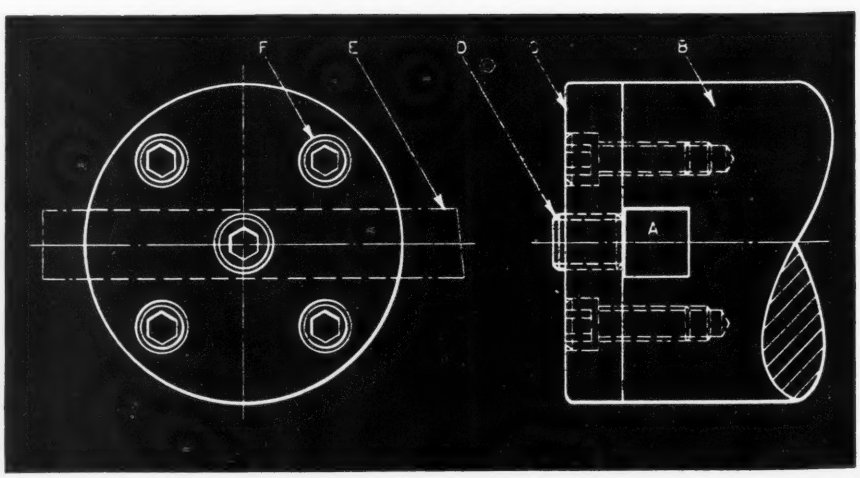
* * *

Meeting of American Machine Tool Distributors' Association

The American Machine Tool Distributors' Association held its twenty-sixth spring meeting at the Edgewater Beach Hotel in Chicago on April 13 and 14. O. W. Johaning, president of the Association and president of Colcord-Wright Machinery & Supply Co., St. Louis, Mo., presided at the sessions. Speakers included Tell Berna, general manager of National Machine Tool Builders' Association, who spoke on "The Machine Tool Industry, New Style"; Frederick B. Scott, president of Syracuse Supply Co., Syracuse, N. Y., who discussed the subject of "Pension and Profit Sharing Trusts"; and Burnham Finney, Editor, *American Machinist*, whose topic was "Wanted: A Sound Replacement Policy."

Reports dealing with overhead expense research, sales and service, and government relations were presented at the general sessions by the chairmen of the different committees. The luncheon on Thursday included a talk by Dr. Hilton Ira Jones, director of Hizone Research Laboratories, Wilmette, Ill., entitled "Peeps at Things to Come." The fall meeting of the Association is scheduled to be held at the Lake Placid Club, Lake Placid, N. Y., in September.

Simple method of producing square tool-bit holes in boring-bars where broaching equipment is not available



Gleason Works Celebrate Eighty-Fifth Anniversary

THE eighty-fifth anniversary of the founding of the Gleason Works, Rochester, N. Y., was celebrated on April 8 with a luncheon at the Oak Hill Country Club, Pittsford, N. Y., and an Open House at the plant of the company from 7 to 10 o'clock in the evening. At the luncheon, the guests were welcomed by James E. Gleason, chairman of the board, and addresses were made by Tell Berna, general manager of the National Machine Tool Builders' Association, whose subject was "The Machine Tool Industry in a Normal World," and by William J. Kelly, president of the Machinery and Allied Products Institute, whose topic was "Looking Ahead." Presentations were made to forty persons who had been connected with the Gleason Works for over thirty-five years.

The earliest predecessor of the Gleason Works was a partnership, Connell & Gleason, which was formed in 1865. One of the partners was William Gleason. This partnership was changed in 1868 to Connell, Gleason & Graham. The original location of the plant was on Brown's Race, overlooking the Genesee River, along whose banks practically all local industrial activities of that day were located.

In the beginning, the concern manufactured engine lathes, planers, and woodworking machinery. Later the partnership was dissolved, after which William Gleason operated an independent business specializing in metal-working machinery. In 1888, the Genesee Foundry Co. was organized, and in 1890 the Gleason Tool Co. was incorporated. These two units were operated separately until 1903, when the Gleason Works became a New York State corporation.

William Gleason invented the bevel gear planer in 1874, this being the first commercially practical method of machining parts for transmitting power around a corner. Up to the time of this development, bevel gears had been cast or were made by inserting wooden teeth in cast-iron rings. It was necessary to finish each tooth by hand filing and chipping, so that the making of bevel gears was a laborious task and an expensive one.

In 1905, the two-tool bevel gear generator invented by James E. Gleason appeared on the market. Not only did this machine produce gears in half the time previously required, but since the side of the tool was employed for cutting instead of the point, a better finish and a smoother rolling gear resulted. In 1908, the first Gleason bevel gear tester was brought out, and in 1913, a process and equipment were developed for cutting the teeth of spiral bevel gears.

From 1915 to 1925, additional machines were designed for bevel gear manufacture, including a quenching press for the controlled hardening of bevel gears, mass-production roughing machines for spiral bevel gears and pinions, an automatic burnishing machine for bevel pinions, the first machine for grinding the teeth of spiral bevel gears and pinions, an automatic lapping machine for spiral bevel gears and pinions, and equipment for making the cutters and tools required on gear-cutting machines.

Another revolutionary development was the invention, in 1925, of a practical method for the manufacture of hypoid gears. In the early 1930's, a spiral bevel gear rougher with a chamfering device was introduced, which was followed by a high-production machine for grinding the teeth of spiral bevel and hypoid gears, and subsequently by a generator for rough- and finish-cutting straight bevel gears. The first machine

The main assembly floor of the Gleason Works, showing a large number of machines in various stages of completion

for flame-hardening gear teeth to increase resistance to wear was also announced.

In the middle 1930's, a machine was produced for finish-cutting Formate spiral bevel and hypoid gears by the single cycle process, and a Revacycle machine was developed for completing straight bevel gears in a single operation. Zerol bevel gears were brought out to meet the needs of the aircraft industry.

Since World War II, the new machines have included a universal type of straight bevel gear generator for producing Coniflex bevel gears, high-speed machines for completing small spiral and straight bevel gears from solid metal, improved grinding machines for curved-tooth bevel gears, new quenching presses, and a special machine for grinding Curvic couplings.

In the early 1890's, William Gleason's daughter Kate and his two sons, James E. and Andrew C., became associated with the company. James E. Gleason concentrated on machine design and production. He was elected president on the death of his father in 1922, and today is chairman of the board. Andrew C. Gleason, until his retirement in 1934, was primarily concerned with the gear designing, manufacturing, and selling phases of the business, while Kate Gleason was interested in the commercial and sales aspects of the business. E. Blakeney Gleason, son of James E. Gleason, has headed the company's activities during recent years. He is now president, treasurer, and general manager of the company, having been elected president in 1947.

Washington Meeting of the American Society of Mechanical Engineers

THE spring meeting of the American Society of Mechanical Engineers, held at the Hotel Statler, Washington, D. C., April 12 to 14, was unusually well attended. Among the subjects dealt with in the machine-building and metal-working fields were metal-cutting research, lubrication, machine design, industrial instruments and regulators, and engineering education.

One of the papers presented at the metal-cutting data session discussed cylindrical grinding. This paper described some results of an investigation of the grinding process with reference to the influence of the grain size of a grinding wheel and the type of grinding compound used on the volume of metal removed, surface finish, temperature increase, and possible injury to the structure of the metal. Another paper dealt with the machining of heated metals, based on studies made of the machinability of several materials at elevated temperatures. Long curling chips and a smooth, clean-cut surface were produced by hot machining in cases where the same materials cut at room temperature had a glazed, uneven surface and powdery chips; an arc-heating method was developed which permitted continuous heating.

At the lubrication session, a paper was read on oil holes and grooves in plain journal bearings. Data were presented relating to bearings having various arrangements of oil holes and grooves, including one, two or four oil holes, or one axial and one circumferential groove in the bearing. Another paper presented at this session dealt with film thickness between gear teeth.

At one of the machine design sessions, tests on the dynamic response of cam follower systems were described. These tests covered parabolic, harmonic, and cycloidal cam profiles with the same type of follower. They showed that the cycloidal profile produced slightly lower peak forces than the other profiles.

A number of interesting excursions to engineering developments and laboratories were arranged. Among these may be mentioned excursions to the United States Naval Ordnance Laboratory at White Oak, Maryland; to the United States Naval Engineering Experimental Station; and to the National Bureau of Standards. The Naval Engineering Experimental Station is engaged in the testing and development of internal combustion engines, bearings, shaftings, welding methods, lubricants, and mounting for gas turbines to overcome shock and vibration. The trip to the National Bureau of Standards featured an inspection of automotive testing equipment, a magnetic clutch demonstration, and visits to the vault containing the primary standards of weights and measures, as well as to the engineering mechanics laboratory containing the largest testing machine in the world.

At the welcoming luncheon of the meeting, the president of the Society, James D. Cunningham, presided, and Ralph E. Flanders, United States Senator from Vermont and a former president of the American Society of Mechanical Engineers, spoke on the subject "A Mechanic in the Senate."

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester, Hankins & Silver
Sales Management Engineers
New York and Philadelphia

Time Each Move in Selling

TIMING can decide the fate of every move in sales strategy. It is one thing to act wisely, another to act at the right time. One great value in studying history is to grasp the significance of "timing"—how, in the past, the successful act has matched opportunity and circumstances—how imminent disaster has followed poor timing. It's so with winning or losing an order for a machine or tools.

Proper timing is a basic idea too often neglected by salesmen. Every day we see orders lost, not by lack of skill or persistence in selling, but only by poor timing. The prospect is like molten metal in the furnace. Every step in handling and forming it depends upon time. If too hot, the metal cannot be formed. If left too long to cool, it is equally difficult to shape.

We often see an excellent sales approach or argument made ineffective, and perhaps damaging, simply through poor timing. One anxious salesman suddenly releases a barrage of arguments, perhaps well aimed, but not timed. "My machine's the best; it's got bigger bearings, higher speed, greater output, closer limits, push-button control, is easier on the operator, smoother running—just look at the finish . . ." He wonders later why he lost the order because he "certainly gave them all the arguments."

Another salesman, faced with a prospect who mentions certain of his machinery problems, fails to take the opportunity of helping him solve them. Time goes relentlessly on and leaves him guessing why he has not convinced the prospect.

Still another salesman hails the shop foreman hurrying down the aisle, and earnestly starts his sales story. The foreman fidgets, his eyes wander, and he finally excuses himself. The salesman's general approach and sales arguments had merit, but completely lacked the right timing.

Setting a properly timed pattern for sales procedure, subject, of course, to change at a moment's notice, is one of the greatest assets an equipment salesman can have. Not being a canvasser, only in the rarest instance must he condense the entire appeal into a matter of moments.

Let us consider the five most important points in timing sales procedure:

1. Time the plan of procedure in cultivating a prospect—Make a mental note of the various steps to be taken. Of course, it is necessary to get acquainted with the purchasing man, but why hound him for an order before selling those who will use the equipment? Each step must be taken in the proper order, the same as in building a structure. No contractor would bring in the painters before walls and woodwork were ready.

2. Time the particular visit—Often the prospect sets the time for an interview, but in some cases the salesman may suggest it. Most office men like an hour first thing in the day to read mail and plan the day's work. On the other hand, shop superintendents have hours assigned for a tour through their plant, and the first thing in the morning may be best for them. Again, most men are more affable after lunch than before. Study the time habits of the prospect. Almost all prospects are faced with a series of differing problems. If only the salesman can find out what problem is uppermost, he can time his visit to fit and gain attention.

3. Time the interview itself—Size up the urgency of the prospect's working schedule. Is he naturally phlegmatic or is he emotional or hurried? What should be the tempo? Should the talk be crisp, closely timed, and promptly concluded; or should it follow a leisurely course? Both the prospect's habits and immediate circumstances should set the pace. Above all, we

should be on our guard, watching for signs of weariness in the prospect, so as to leave him wanting to see us again.

4. Time the thesis, remark, argument—Each remark and argument should be made at the proper time and should be suited to the individual prospect. Orders are not made in a day. Most minds are best impressed by one clear-cut idea. Time remarks so that one idea is firmly established in the prospect's mind and leave other points for a subsequent visit.

5. Time the proper use of sales tools—Exhibiting a sample at the right time may be very effective in clinching a sales point. Promotional material and engineering data should be directed to the prospect when they meet the prospect's mood and problem. Bringing in supporting technical talent, if properly timed, will often complete an otherwise inadequate sales presentation.

Selling, after all, is teaching (not preaching), and the same principles apply. The successful teacher times both lessons and ideas.

New Officers of the A.S.T.E.

HERBERT L. TIGGES, vice-president of Baker Brothers, Inc., Toledo, Ohio, was elected to the presidency of the American Society of Tool Engineers during the annual meeting, which was held in Philadelphia April 10 to 14 coincidentally with the Industrial Cost-Cutting Exposition sponsored by the Society. The new first vice-president of the Society is J. J. Demuth, methods engineer and general superintendent, Sligo, Inc., St. Louis, Mo. H. E. Collins, engineer, Hughes Tool Co., Houston, Tex., was elected second vice-president; and Roger F. Waindle, Elgin National Watch Co., Aurora, Ill., was elected third vice-president. W. B. McClellan, Gairing Tool Co., Detroit, Mich., and George A. Goodwin, Standard Electric Co., Dayton, Ohio, were re-elected national secretary and treasurer.

A research foundation to carry on basic production research was authorized at the annual meeting of the board of directors, and an initial fund of $25,000 was appropriated for this foundation. Plans call for the use of existing facilities at various universities and colleges. The foundation also will assist small industries or companies not in a position to finance such research.

A $25,000 scholarship fund offered by an anonymous Chicago concern to permit an increased number of tool engineering scholarships in the state of Illinois was accepted by the board of directors; an honorary membership was awarded to Senator Ralph E. Flanders of Vermont for "lifetime contributions to tool engineering"; and a life membership was awarded to E. W. Ernst, chairman of the Handbook Committee, for his contributions toward the compiling and publication of the "Tool Engineers' Handbook."

New officers of the American Society of Tool Engineers. Front row (left to right), H. E. Collins, second vice-president; H. L. Tigges, president; J. J. Demuth, first vice-president. Back row (left to right), George A. Goodwin, treasurer; Roger F. Waindle, third vice-president; W. B. McClellan, secretary; W. A. Thomas, assistant secretary-treasurer

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

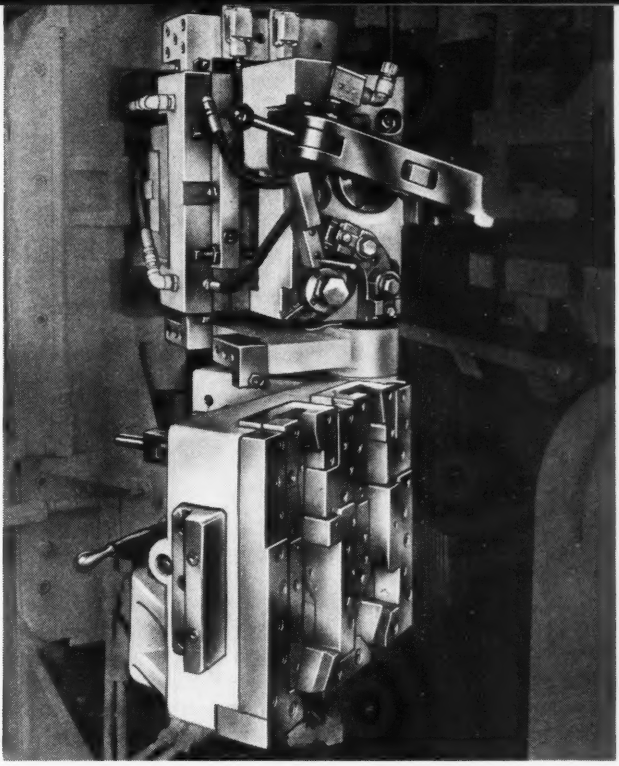


Fig. 2. Close-up view of fixtures on machine shown in Fig. 1, with upper fixture in broaching position and lower one in loading position

Lapointe Double-Ram Horizontal Surface Broaching Machine

Broaching of automobile cylinders connecting-rods, and similar parts that must be turned out at high production rates can be handled efficiently on a double-ram horizontal surface broaching machine recently developed by the Lapointe Machine Tool Co., Hudson, Mass. This powerful, versatile machine is being built in a 15-ton size, as shown in Fig. 1, and in a 25-ton size. It is available in three stroke lengths of 66, 90, and 120 inches.

The double ram and quick-acting fixtures designed for these machines eliminate loss of time in loading and permit continuous operation. High production is obtained with this equipment, since one work-holding nest can be loaded while the other is in the broaching position, as shown in the close-up view, Fig. 2. This illustration shows details of the fixtures designed for semi-automatic or full-automatic operation.

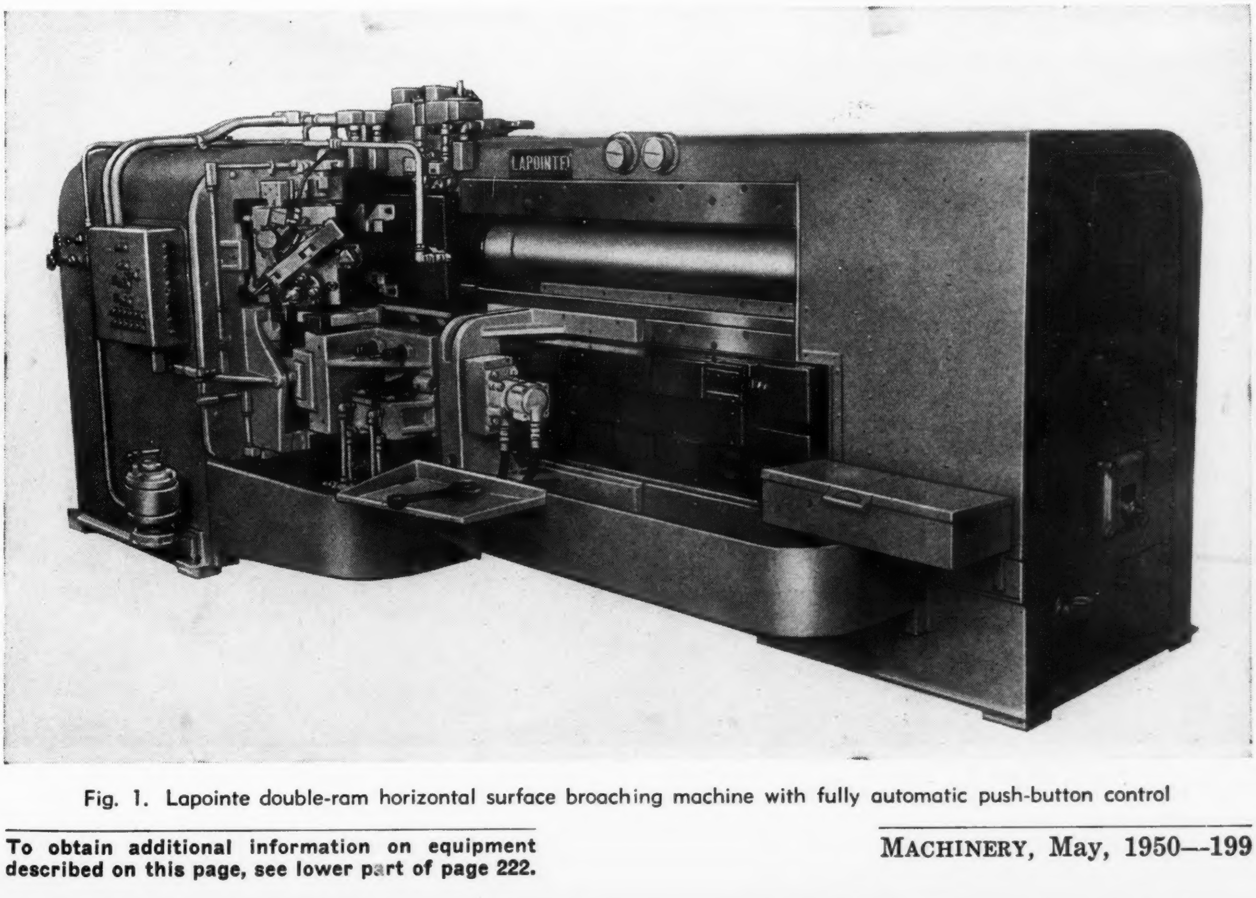


Fig. 1. Lapointe double-ram horizontal surface broaching machine with fully automatic push-button control

To obtain additional information on equipment described on this page, see lower part of page 222.

Fig. 3. Connecting-rods broached on machine equipped as illustrated in Fig. 1

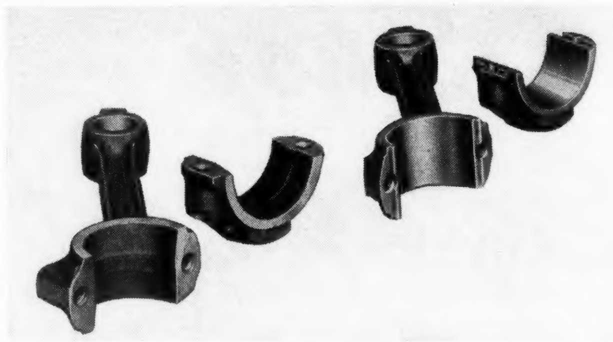


Fig. 4. Connecting-rods and caps broached on machine equipped as shown in Fig. 5

They are built with fully interlocked, staggered, swinging type work-tables of extra heavy section and large size to accommodate work-holders of many types. In Fig. 1 the upper fixture is shown in the loading position, while the lower one is in the broaching position. In Fig. 2 the upper fixture is shown in the broaching position and the lower in the loading position.

The lower broach shown in the machine in Fig. 1 can be adjusted by means of a tapered gib for broaching seven different sizes of connecting-rods of the type shown in Fig. 3. Connecting-rods and caps such as shown in Fig. 4 can be completely broached from rough forgings on the machine equipped as shown in Fig. 5. With this equipment, one complete connecting-rod and cap are finished every sixty-five seconds, with a cutting speed of 25 feet per minute.

The electric dual control panel has two distinct sets of controls. The set of push-button controls located on the face of the panel, as shown in Fig. 1, is employed for setting-up purposes. Individual buttons of this group can be used to control any part of the machine independently of any other part. The controls on the right-hand end of the control box, within easy reach of the operator, are employed for automatic operation; while these controls are in use, the full electrical interlock system is in effect and the buttons on the face of the panel are inoperative.

The hydraulic system includes a vane type pump and an oil reservoir. The main motor of the 15-ton machines is 30 H.P., and that of the 25-ton machines, 40 H.P. The machines are equipped with 1/2-H.P. coolant motors and coolant reservoirs. The 15-ton machine has a height of 76 inches, and the 25-ton machine a height of 82 inches. The smallest machine requires a floor space of 185 by 90 inches, and the largest 315 by 102 inches. The smallest and largest machines weigh 47,600 and 84,400 pounds. 61

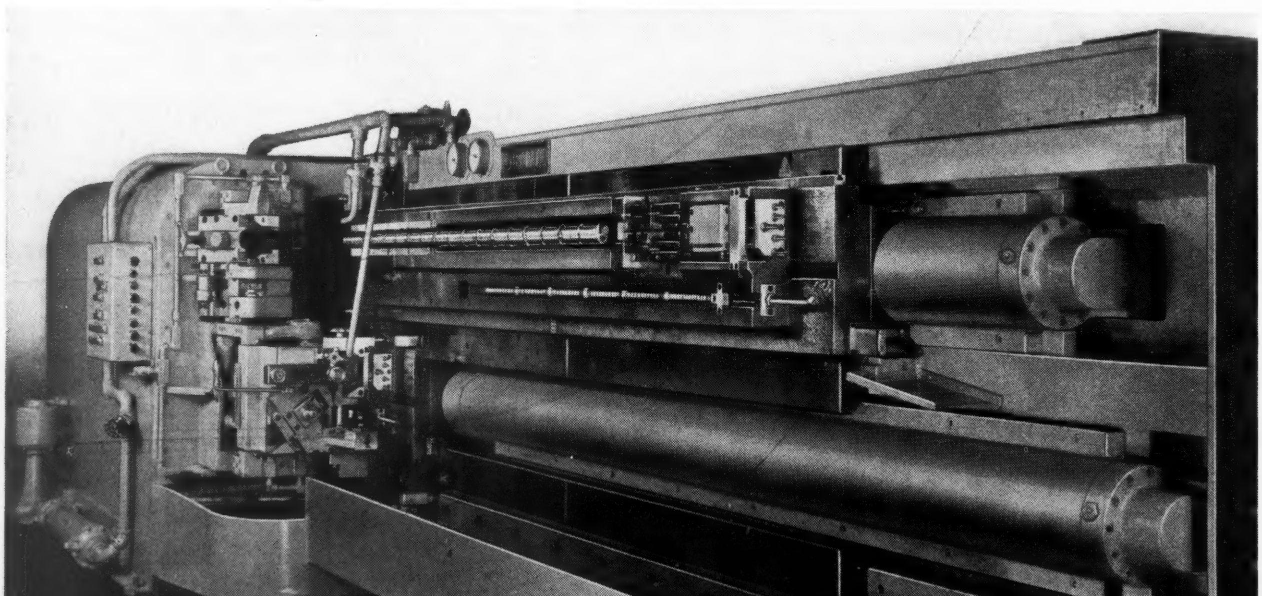


Fig. 5. Lapointe broaching machine operated by new variable-speed low-pressure hydraulic system

To obtain additional information on equipment described on this page, see lower part of page 222.

Coordinator Precision Hole-Positioning Attachment for Boring and Milling Machines

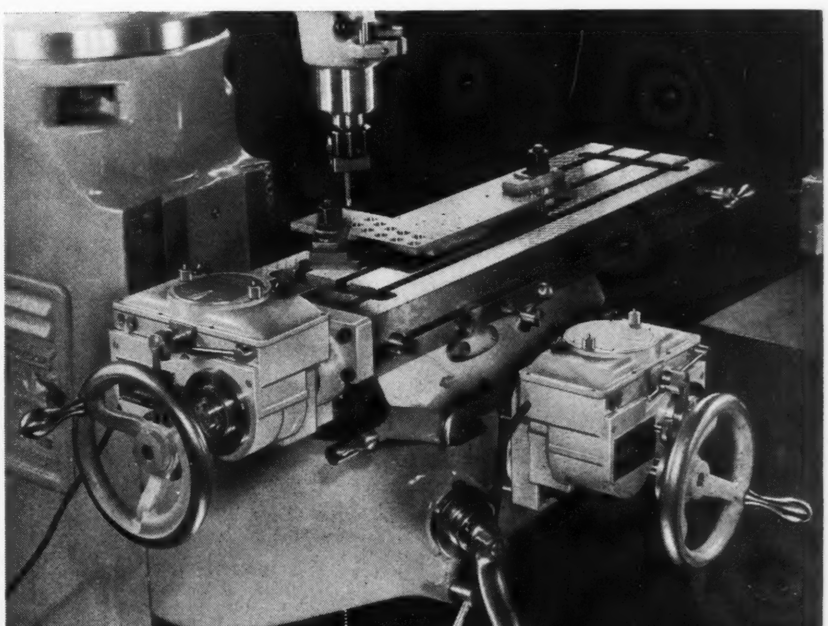
The Benzon Machine Co., Seventh and Washington Ave., Lansdale, Pa., has developed coordinator attachments for vertical boring and milling machines and horizontal boring machines which enable the unskilled operator to locate accurately a pattern of holes and reproduce the pattern as often as desired through the use of pre-formed records cut on micro-pattern cylinders. The coordinators are designed to compensate for errors in the pitch of traverse screws and racks in applications where the errors exceed the specified tolerance.

These coordinator attachments are built to expedite small-lot production and insure accurate work and accurate duplicating of lay-outs and hole drilling patterns. They do not convert the machine tool into a jig borer, but they do relieve jig borers of many jobs that can be performed on the coordinator-equipped machine operated by less highly skilled men.

On work requiring laying out preliminary to drilling and boring, the coordinators can be used to lay out and center-drill hole-patterns more accurately and rapidly than is possible on a regular lay-out table. Coordinators, as the name implies, use the ordinate system of hole location, combining ordinate dimensions from two perpendicular base lines for locating the centers of the holes to be machined. The ordinates combined in the coordinators are first recorded with micromatic accuracy on cylindrical records called "micro-patterns." These patterns are cut on a small portable machine called the recorder. With the micro-pattern records mounted in the coordinator, the operator can set the machine for drilling every hole position recorded to a high degree of accuracy without reference to a drawing or to any other conventional measuring means. The micro-patterns can be readily stored and used for repeat orders. The micro-pattern blanks are made from a synthetic resinoid plastic which is highly resistant to atmospheric changes.

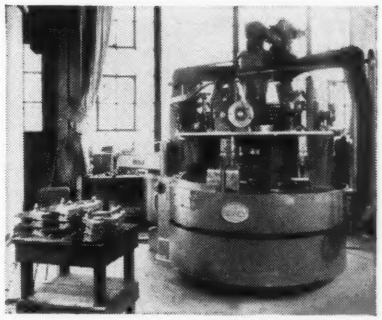
Operation of the coordinator is simplified by red and blue charts located under plates of corresponding colors on the coordinator. These charts are set to the required positions by turning knobs on the front of the coordinators. The same number and letter must appear in their proper positions on both control plates, that is, the number at the top of the opening in the red plate must show at the lower position in the blue plate, while the letter at the top in the blue plate must show at the lower position in the red plate.

The work is then traversed toward the correct position for drilling one of the holes until a yellow light signals that the work is close to the required position. The red light is then turned on by depressing a lever. The work is now moved slowly forward to the exact position, at which time the red light goes out. This indicates the location of one ordinate. When the lever is released, both lights stay out. The other traversing screw is then turned, and the same procedure followed in locating the correct position determined by the other ordinate. When both yellow and both red lights remain out, the work is accurately positioned. 62



Coordinators attached to a milling machine to position work rapidly and accurately for locating according to predetermined lay-out

Besly "Roto Rotary" Grinder



"Roto-Rotary" grinder developed by Charles H. Besly & Co.

Flat surfaces of large units can be ground to close tolerances on a high production basis by a machine developed by Charles H. Besly & Co., 122 N. Clinton St., Chicago 6, Ill. This new No. 372 72-inch "Roto-Rotary" grinder is especially adapted for grinding gear casings and other large castings ranging from 3 to 7 inches thick.

The work-holding fixtures are suspended from a rotary table located in a stationary drum that is mounted on three legs attached to the machine base. The rotary table revolves around a central shaft to which four roller chains are geared. The chains, extending outward, drive four vertical shafts which are flanged at their lower ends to receive the work-holding fixtures.

The fixtures are made from 1/2-inch thick mild steel plate with torch-cut openings to accommodate the work. Each work-hold-

To obtain additional information on equipment described on this page, see lower part of page 222.

ing station has openings to receive two castings. Pressure plates, equipped with spring bearing studs, hold the work on the abrasive wheel. The grinding pressure can be adjusted by the operator, so as to remove the desired amount of stock and obtain flatness within the required tolerance. 63

P & W Jig-Borer Table with Precision Built-In Rotary Section

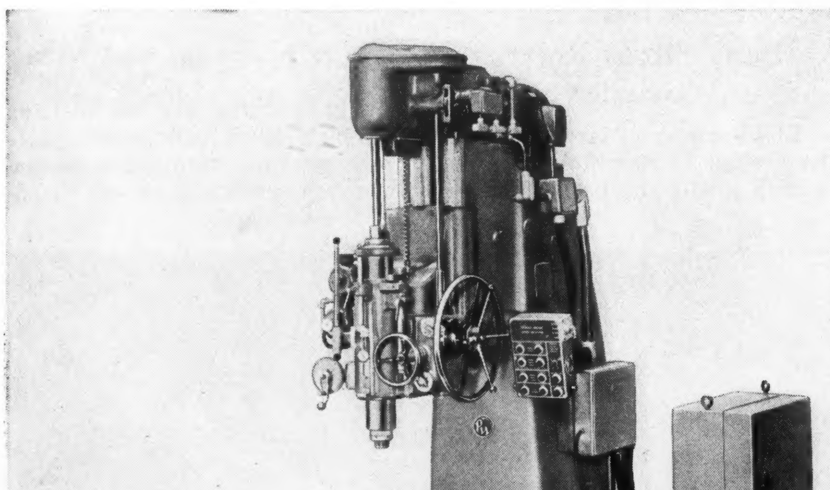
A new design of table for jig borers has just been announced by Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn., which is available on the company's No. 4E jig borer, recently brought out. This table provides a large rectangular work area, with ample T-slots for holding down work, and has a precision built-in auxiliary rotary table for circular indexing and polar coordinate work. The rectangular dimensions of the table are 36 by 78 inches, and the rotary table is 48 inches in diameter.

The top surfaces of both rectangular and circular tables are accurately hand-scraped to insure a high degree of flatness. The circular table is made higher by 1.000 inch ($\pm$ 0.0005 inch) than the rectangular part of the table to provide clearance when indexing work larger than 48 inches in diameter. The full 36- by 78-inch working surface is utilized by placing 1.000-inch parallels on the rectangular part table.

To provide the maximum rotary work range for which the No. 4E jig borer is capable, the center of the rotary table is located 6 inches off center to the left relative to the rectangular table. This increases the table travel between machine-spindle and rotary-table center lines from 30 to 36 inches when the table is traversed to the left.

When the rotary table is centered under the spindle, the maximum work-piece diameter that will clear the machine column is 72 inches. Boring can be accomplished on any diameter of such a piece from 0 to 72 inches by traversing the table to the left. By moving the center of the rotary table outward the maximum permissible amount from the spindle center line, a work-piece of 108 inches in diameter can be accommodated and still clear the column. However, the minimum boring diameter is limited to 36 inches. By traversing the table the maximum amount to the left from this point, the boring diameter can be increased to a maximum of 80 inches. The maximum diameter work that will clear the column in this position and permit rotation is 118 inches.

Push-button controlled power rotation in either direction is provided for rapid indexing. Graduations in degrees are marked on a beveled edge around the entire periphery of the table for approximate indexing. Precision settings to minutes and seconds are obtained through the slow-motion hand control wheel. Indexing in either direction from zero and return to the original zero can be accomplished within a spacing tolerance of $\pm$ 15 seconds in the full 360 degrees of rotation. 64



Pratt & Whitney jig borer with table of new design, comprising a rectangular and a precision built-in rotary table

Improved Lubrication Method for Bliss Press Clutches

The E. W. Bliss Co., Toledo 7, Ohio, announces an improvement in the method of lubricating the rolling key clutch used on the inclinable presses made by the company. An oil-impregnated bearing which needs to be oiled only after each forty hours of operation will now be a regular feature of Bliss press clutches. These new so-called "oilless" bearings retain the oil within their porous structure. After the bearing reaches the operating temperature, the oil expands and completely lubricates the working surfaces of the clutch.

An outer peripheral groove is provided in the bearings which serves as a reservoir. The oil supply contained in this groove seeps into the bearing and reaches the surfaces to be lubricated in the right amount. The "oilless" bearings are so designed as to be interchangeable with the bronze bushings previously furnished. Neoprene seals are not required with the new bearings. 65

To obtain additional information on equipment described on this page, see lower part of page 222.

Colonial Broaching Machines with Standardized Controls

An important development in the line of broaching machines produced by the Colonial Broach Co., Box 37, Harper Station, Detroit 13, Mich., including single- and dual-ram surface broaching types and pull-up and pull-down internal broaching models, is the redesign of these machines to conform to the new standards of the Joint Industry Conference.

All electric controls are now group-mounted in the single external dust-protected panel, and all hydraulic controls are similarly group-mounted on the panel on the opposite side of the machine column. Motorized pumps are so located that they can be changed in approximately one hour's time. Filters consist of individually replaceable cartridges which are externally accessible. The filters, as well as the hydraulic control valves, can be replaced without draining the machine.

The various electric and hydraulic control units have been standardized and are interchangeable. They are designed for easy maintenance and service. The arrangement of these standardized units makes it far easier than formerly to incorporate almost any desired type of automatic control in the machines, interlocked with the machine cycle. This includes automatic clamping and unclamping, and loading and unloading, automatic indexing or magazine feeding controls, and interlocking arrangements with other machines for transfer operations. 66

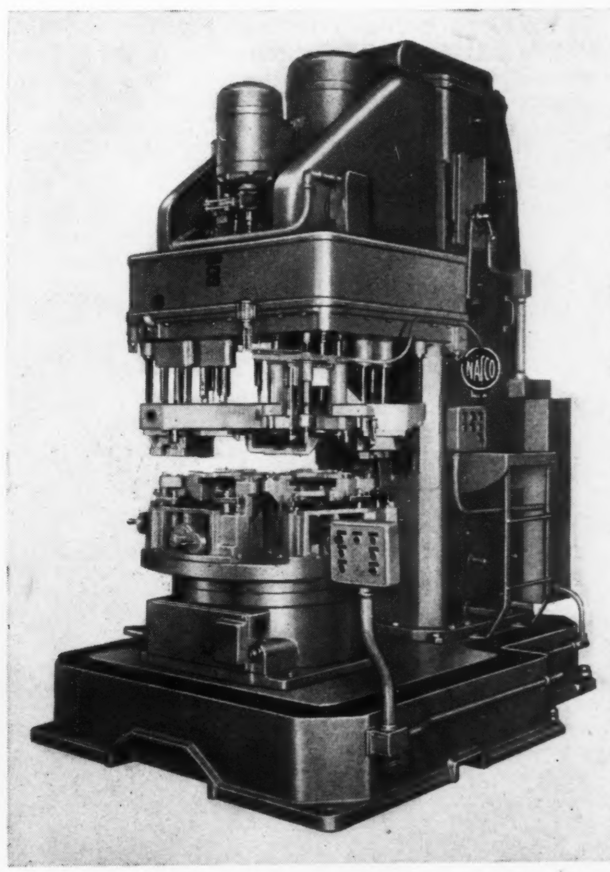
Natco High-Production Automatic Multi-Operation Machine

A new automatic, multi-operation "Holesteel" machine has been designed by the National Automatic Tool Co., Richmond, Ind., that performs 2700 operations per hour at each of four positions simultaneously. These operations include drilling, reaming, rough- and finish-counterboring, chamfering, spot-facing, and tapping both sides of automatic transmission "Servo" covers at the rate of 90 parts per hour.

There are two work-holding fixtures at each station. One of these fixtures holds the work with one face down, and the other fixture holds the work in the reverse position. With this arrangement, the operator unloads a finished part from one of the fixtures at the first or loading position and replaces it with a piece taken from the other fixture, reversing the latter piece so that succeeding operations will be performed on the opposite face. Thus one finished piece, machined on both sides, is completed at each indexing movement.

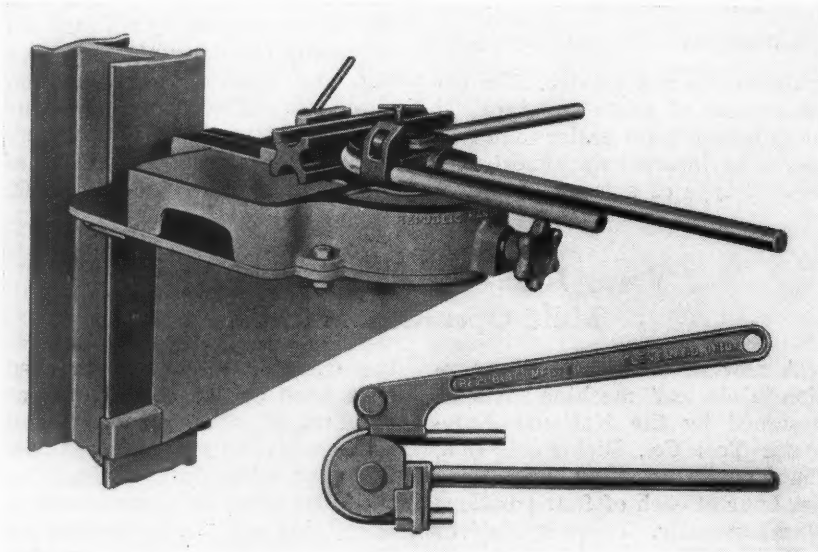
At the second position, eight 11/32-inch diameter holes are drilled in the new piece of work, while the piece transferred to the other fixture has three 1/4-inch diameter holes drilled, one hole reamed to 0.250 to 0.260 inch diameter, and one hole drilled for

Colonial broaching machine with g oup-mounted standardized hydraulic controls



Natco multi-operation machine for processing automatic transmission "Servo" covers

To obtain additional information on equipment described on this page, see lower part of page 222.



Tube-benders recently announced by Republic Mfg. Co.

a 10-24 tap. At the third position, three 11/32-inch diameter holes are drilled, one hole is reamed to 0.2465 to 0.2475 inch, and one hole is drilled for a 11/16-16 tap in one of the covers. In the cover held in the other fixture, one hole is rough-counterbored to 0.838 to 0.839 inch in diameter and one hole is chamfered.

At the fourth position, one hole 0.2465 to 0.2475 inch in diameter is reamed, one boss 1 1/16 inches in diameter is spot-faced, one hole is drilled for reaming to a diameter of 0.250 to 0.260 inch, and one 11/32-inch hole is drilled in the cover held in one fixture. One 2 3/16-inch diameter hole is counterbored, two 1/4-inch holes are drilled, and one hole is finish-counterbored to a diameter of 0.838 to 0.839 inch in the cover held in the other fixture.

In the fifth position, one hole is tapped with an 11/16-16 tap in the cover held in one fixture, while one hole is tapped with a 10-24 tap in the cover held in the other fixture. 67

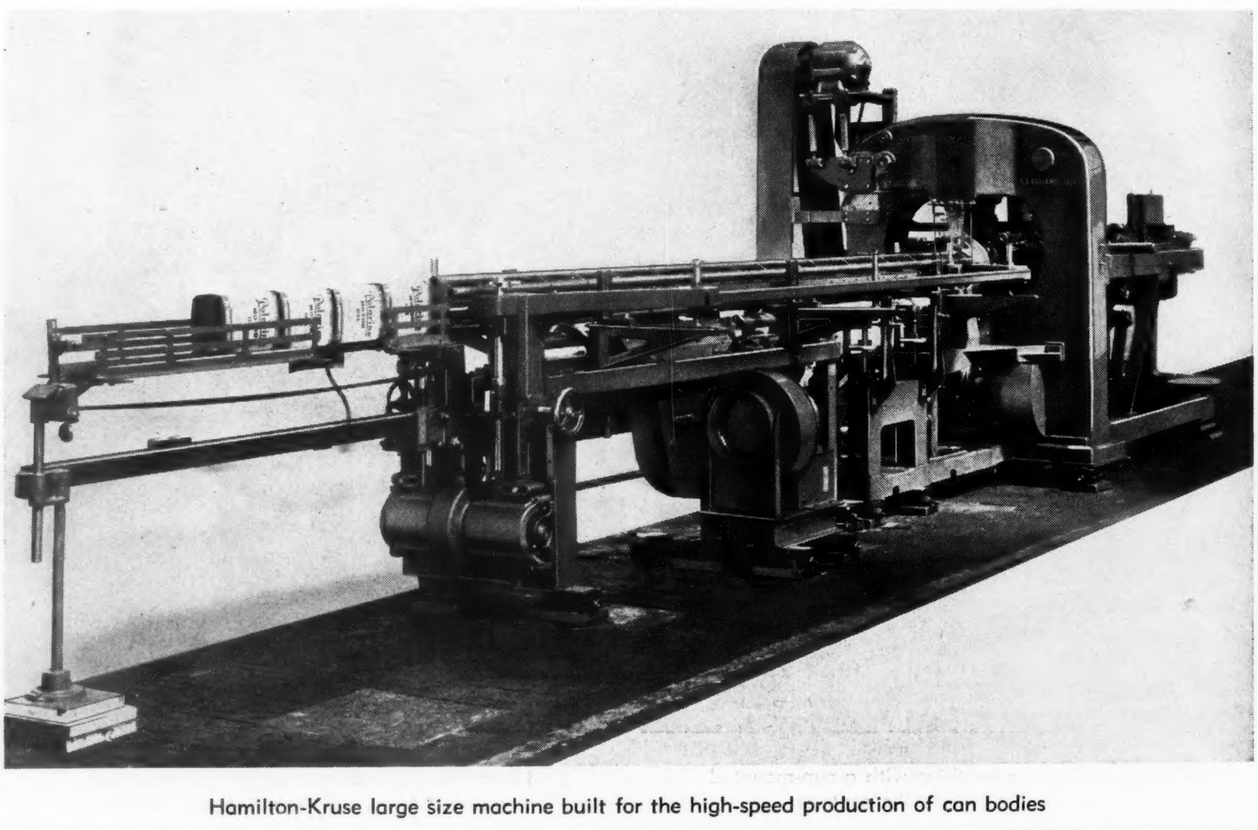
Republic Tube-Benders

The Republic Mfg. Co., 1930 W. 77th St., Cleveland 2, Ohio, has brought out three new tube-benders that have a capacity for bending 1/4- to 1 1/4-inch tubes. The bench type bender will handle tubes from 3/8 inch to 1 1/4 inches. The bender can be post, bench, or stand mounted. Two models of hand benders, Nos. 38 and 39, handle tubes ranging in size from 1/4 to 1/2 inch, and from 5/8 to 3/4 inch, respectively.

Tubing of soft copper, brass, aluminum, or fully annealed steel can be bent accurately to the desired angles. 68

Hamilton-Kruse Can-Making Machines

The largest of the line of can-making machines built by the Hooven, Owens, Rentschler Co. Division, Lima-Hamilton Corporation, Hamilton, Ohio, is shown in the illustration. This new No. 203 bodymaker is designed for the high-speed production of can bod-



Hamilton-Kruse large size machine built for the high-speed production of can bodies

To obtain additional information on equipment described on this page, see lower part of page 222.

ies ranging from 4 1/2 to 10 1/2 inches in diameter, and from 3 to 14 inches in height.

The unit can handle flat blank lengths ranging from 14 1/2 to 33 or 38 inches. Equipped with a 5-H.P. individual motor drive and a 1-H.P. flexer motor running at 1800 R.P.M., it has a maximum production of sixty large can bodies per minute. The machine weighs approximately 25,000 pounds, including the soldering attachment, and occupies a floor space of 92 by 77 inches. 69

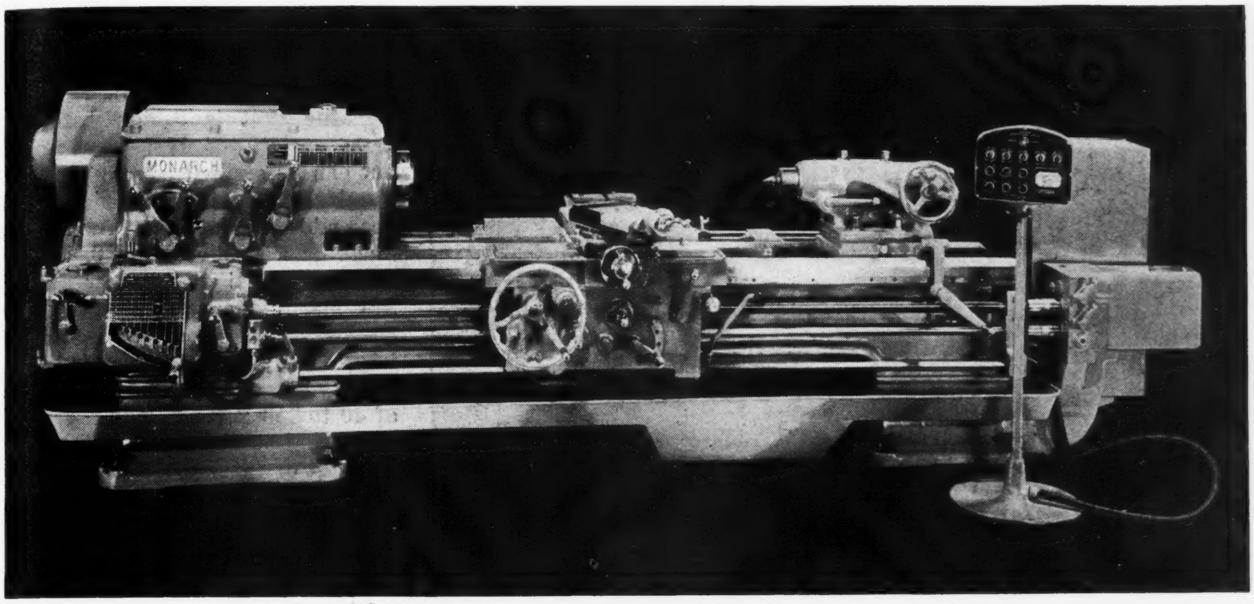


Fig. 1. Monarch engine lathe equipped with new "Motor-Trace"

Monarch "Motor-Trace" Equipment for Duplicate Shaft-Turning

A new tracer-controlled method has been developed for fast, economical shaft turning by the Monarch Machine Tool Co., Sidney, Ohio. The equipment designed for this tracer-controlled duplication method, known as the "Motor-Trace," is applicable to all Monarch engine lathes from the 14-inch size up to and including the 20-inch Model M machines. It is a motor-driven, electrically operated duplicating device, designed to convert new lathes within these sizes into automatic-cycle units capable of producing small lots of two or three pieces with the economy ordinarily associated only with long production runs.

Tracing with this new device can be accomplished through the use of gage-blocks, micrometer heads, or a templet. Thus the unit can be readily adapted for handling straight, multiple-diameter, shaft-turning work in any desired size within the normal capacity of a machine equipped with the attachment. Also, it can be used for step-boring and step-facing; and when tracing is from a templet, such work as tapers, contours, radii, or chamfers can be turned.

It is claimed that finger-tip control of the automatic cycle from a single pedestal type station enables an operator to handle two machines on most work with less fatigue than he would experience in operating one manually-controlled lathe. Equally important, the "Motor-Trace" can be disengaged in thirty seconds or less, so that the machine can be quickly converted from automatic-cycle to conventional engine-lathe operation. Application of the attachment does not reduce the normal swing capacity of the lathe. The complete electrical control can be located at the point most convenient to the operator. 70

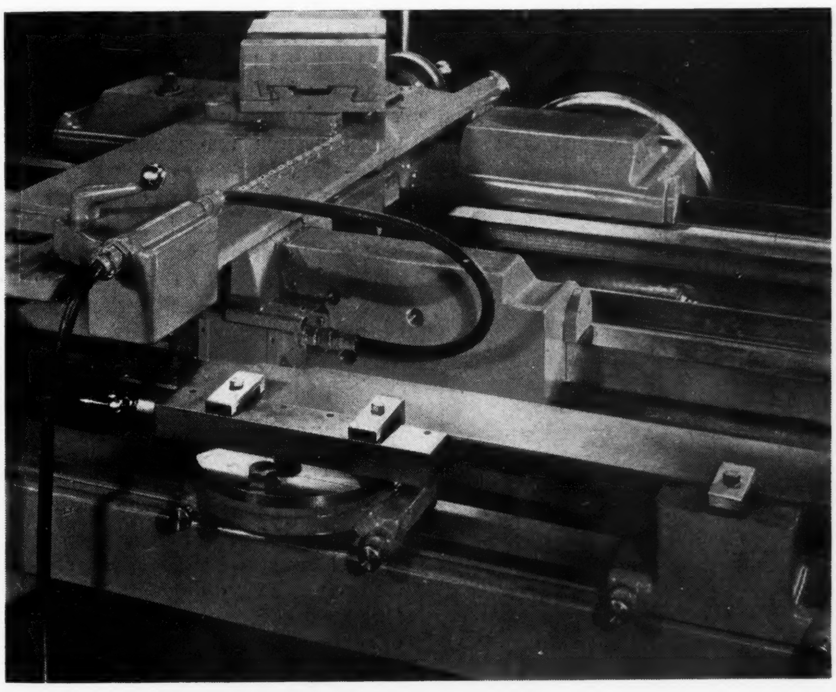
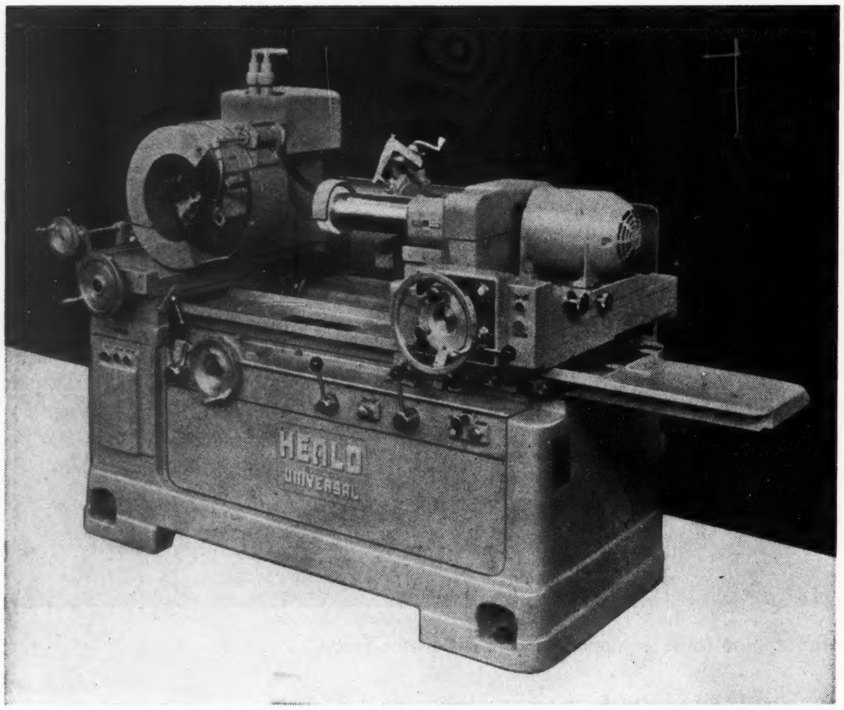
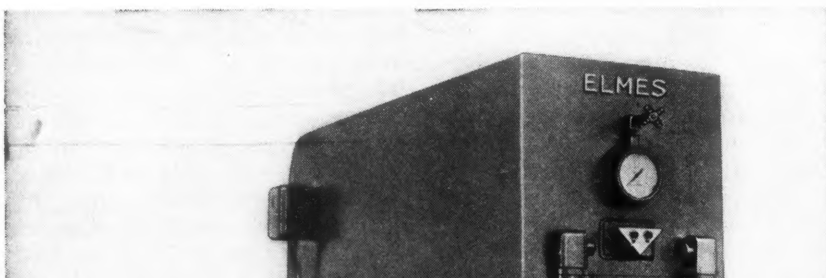


Fig. 2. Flat templet used with "Motor-Trace" equipment shown in Fig. 1 for work requiring taper, radii, or chamfer machining operations

To obtain additional information on equipment described on this page, see lower part of page 222.



Universal internal grinding machine built by the Heald Machine Co.



Elmes open-side press designed for shearing, riveting, and straightening forged-steel parts

Heald Universal Internal Grinding Machine

A universal internal grinding machine that is designed for a wide variety of tool-room work but can be applied equally well to regular production operations has been added to the line of the Heald Machine Co., Worcester 6, Mass. The work-head on this new Model 274 machine can be swiveled to 90 degrees. It is driven hydraulically, and provides for an infinite variety of speeds within the range of 40 to 350 R.P.M. The machine will grind straight or taper holes, straight or taper cylindrical work, and flat or convex surfaces........71

Elmes Open-Side Press

The development of a new Elmes open-side hydraulic press is announced by American Steel Foundries, Elmes Engineering Division, Cincinnati 29, Ohio. This press, originally designed for a prominent manufacturer of farm implements, performs three operations per cycle—shearing, riveting, and straightening of forged-steel parts—at the rate of thirty-five cycles per minute.

Since the work handled is subject to variations in thickness, the multiple operations performed on a single stroke require precise application and accurate regulation of pressure. To meet these requirements, hydraulic power has been utilized.

The moving platen of the press is 18 by 16 inches, and has a stroke of 3 inches. Rapid advance, slower pressing speed, and rapid return are provided by a high- and low-pressure pump. A photo-electric safety control stops the platen immediately if an obstruction breaks the light beam at the entrance to the dies. This press can be provided in sizes and capacities for practically all service needs. 72

Cross Planet Carrier Milling Machine

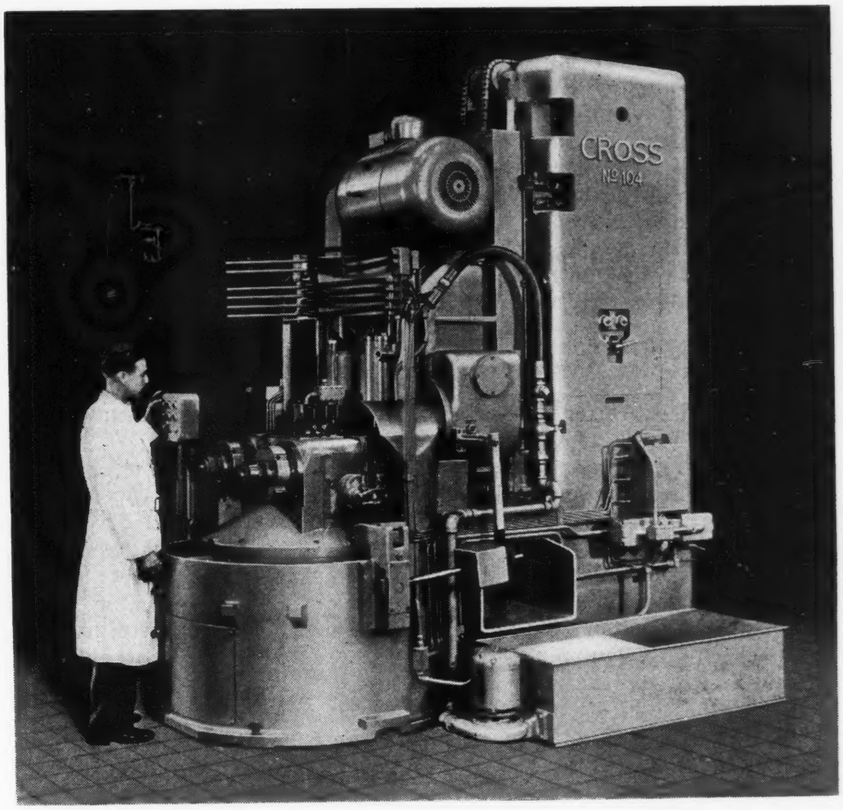
A special machine tool for milling planet carriers has been designed and built by The Cross Company, Detroit 7, Mich. With this new equipment, one unskilled operator can plunge-mill three gear clearances on eighty-five front and eighty-five rear planet carriers, or a total of 170 parts

To obtain additional information on equipment described on this page, see lower part of page 222.

per hour, at an operating efficiency of 100 per cent. This rate is made possible by the use of a two-station index-table which permits loading two pieces at the first station while two other pieces are being milled at the second station.

A fluid motor drive is used to index the work-spindles and the index-table. Clamping is accomplished by a gravity-operated cam. The cutter-spindles are worm-gear driven, and a 450-pound flywheel is attached to each spindle. These features make possible a cutting speed of 425 surface feet per minute.

Other features include hydraulic feed, rapid traverse, and the use of standard Cross sub-assemblies to facilitate maintenance, reduce "down time," and provide flexibility for part design changes......73



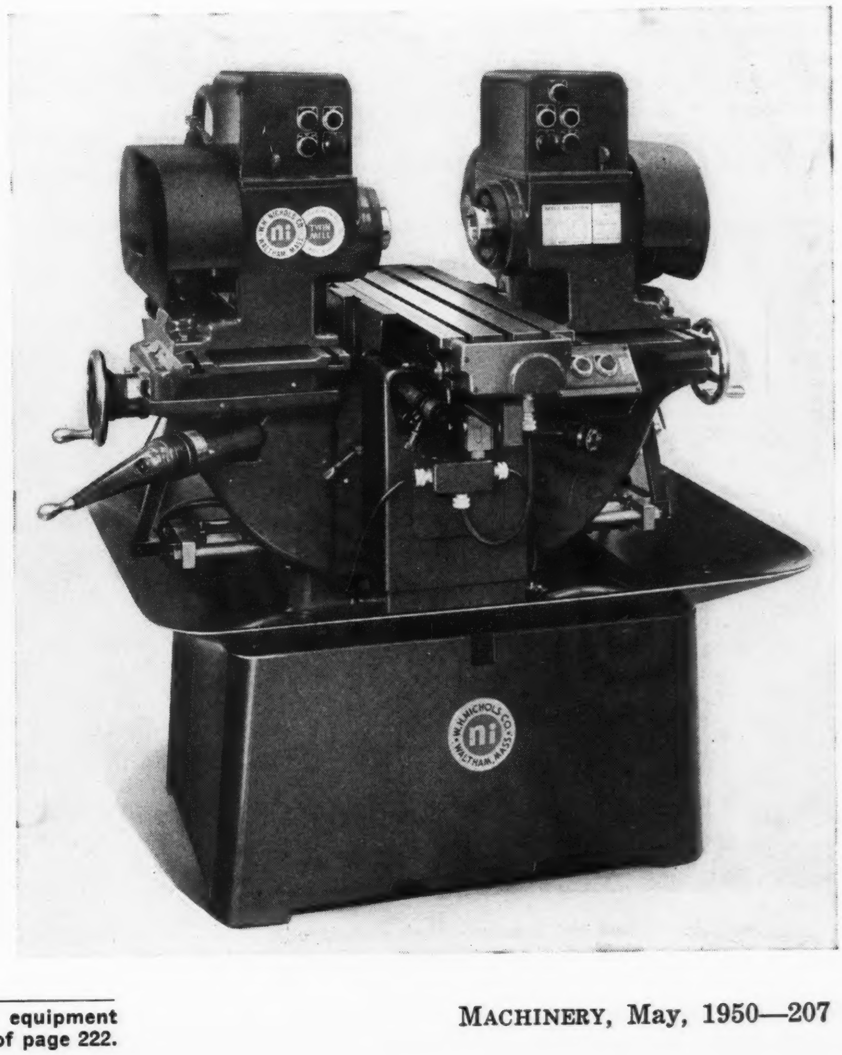
Special machine for milling planet carriers, built by The Cross Company

Improved Nichols "Twin Mill"

The Nichols-Morris Corporation, 50 Church St., New York 7, N. Y., has announced the development of a new "Twin Mill" designed for the low-cost milling of small parts at high production rates. This machine is built to mill two or more surfaces simultaneously, yet it requires only one fixture and one operator. It can be quickly set up for short-run work, but is primarily intended for automatic high-speed light milling operations on precision parts of any machinable material.

The two geared-head milling units are mounted opposite each other on knee and saddle assemblies of conventional design. The table reciprocates automatically between the two milling heads. Each head is V-belt driven by a 1-H.P. motor. Direct drive provides five high spindle speeds from 700 to 2050 R.P.M., and changing the driven pulley makes available ten additional geared speeds ranging from 55 to 590 R.P.M.

The saddles carrying the milling heads have micrometer screw feed traverse adjustments, and the knees supporting the saddle and head assemblies have similar vertical adjustments. Thus either head can be independently adjusted up or down and in or out. The milling heads can also be off-



"Twin Mill" announced by the Nichols-Morris Corporation

To obtain additional information on equipment described on this page, see lower part of page 222.

set in the horizontal plane. Either or both heads can be provided with a right-angle milling attachment for vertical milling.

The machine table is arranged for automatic operation by an air-hydraulic system which provides for rapid approach to the cutting position, infinitely variable hydraulically controlled cutting feed, and rapid traverse to the starting position. For work that must be indexed between cuts, special provision can be made for automatic repetition of the table feed cycle and automatic indexing of the work.

The complete push-button control system on each milling head facilitates operation of the heads independently or in unison, either forward or reverse. 74

Michigan Automatic Gear-Checking Recorder

Permanent chart records of involute tooth forms, tooth spacing, leads, contours, thread forms, etc., can be obtained on an improved automatic checking recorder made by the Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich. Designed primarily as an accessory to the Michigan "Sine-Line" gear-checking equipment, the Model MTR-1 recorder has many other useful applications. Up to 0.002 inch of error, both plus and minus readings, can be recorded automatically across the chart of this instrument.

Outstanding among the improvements are a selective two-speed chart drive and a new standardized interchangeable precision electronic gage-head. The head is mounted in tandem with the indicator on a checker. Either one head can be used and transferred from one checker to another, or all checkers can be equipped with identical gage-heads for plugging into the recorder.

Accuracy of the new checking recorder has been improved by the all-electric two-speed drive and improved pen mechanism. Pen movement is 1/8 inch per 0.0001 inch of checker indicator finger movement. Chart drives give 1/2 inch of travel for either 2 or 1 degree of work rotation. The electronic amplifier is designed to take care of normal voltage changes, so that such fluctuations do not affect the accuracy.

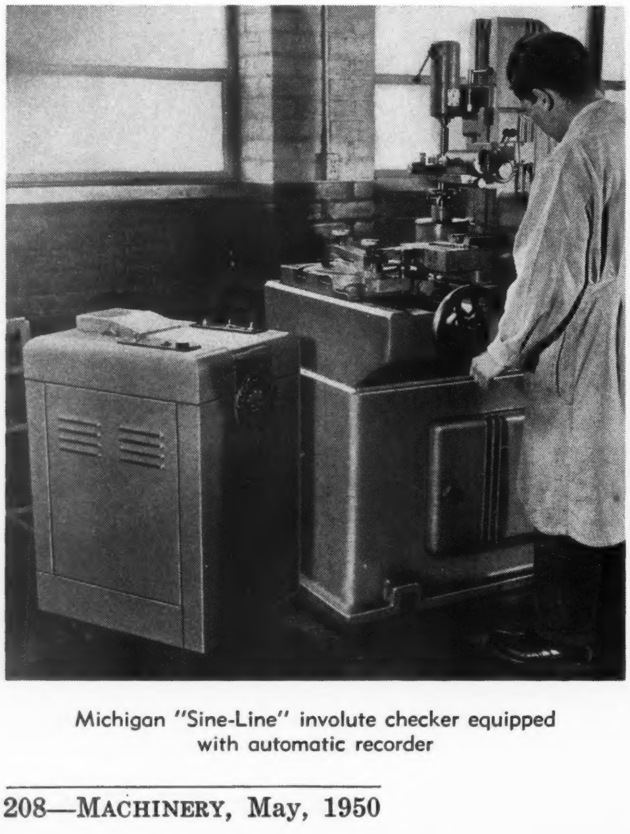
Set-up of the instrument when switching from one type of checking operation to another is extremely simple. There is a convenient compartment in the base of the recorder for storing spare rolls, inks, ink pad, etc. A specially designed hand stamp is provided for indicating what filing data should be filled in on each completed chart. A graduated handwheel is provided for manual operation when automatic operation is not desired. The recorder is mounted on rubber wheels for added protection when rolling it from one location to another. 75

Parts Cleaner with "Whirlpool" Action

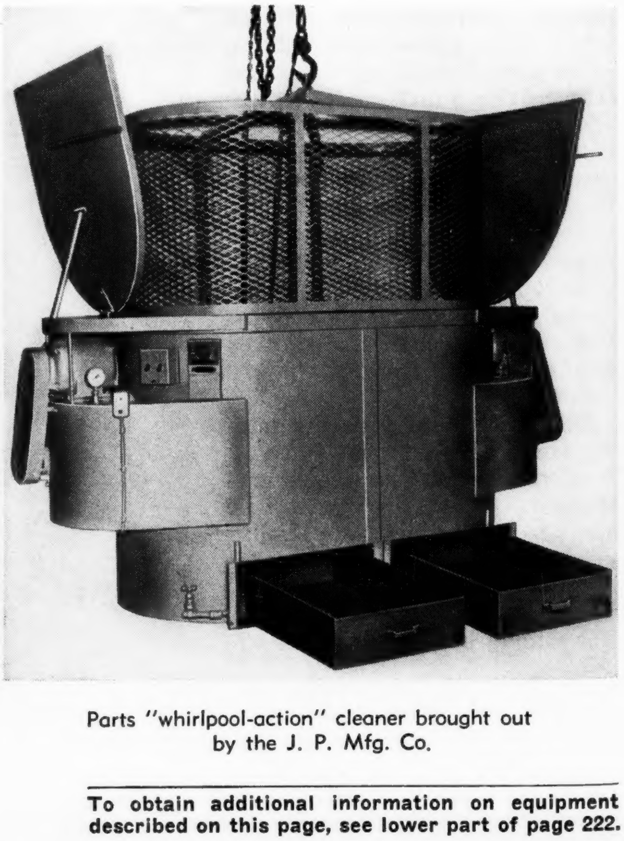
The J. P. Mfg. Co., 330 E. Front St., Youngstown 3, Ohio, has developed a "whirlpool-action" degreaser, washer, and cleaner for industrial and automotive cleaning. This cleaner is designed to remove grease, sludge, paint, rust, carbon, and other accumulated deposits in one operation.

A propeller drives all the cleaning solution at the rate of between fifty and sixty miles per hour to build up tremendous pressure against all external and internal surfaces of the materials to be dissolved or forcibly removed and eliminate the necessity of scrubbing, scraping, or steaming. The cleaner traps all the dirty deposits in a drawer in a compartment below the heating surfaces of the equipment. The sediment pan in this drawer can be removed and cleaned while the solution remains in the tank.

The cleaner basket is rotated by a separate motor at a very slow speed. This allows the solution



Michigan "Sine-Line" involute checker equipped with automatic recorder



Parts "whirlpool-action" cleaner brought out by the J. P. Mfg. Co.

To obtain additional information on equipment described on this page, see lower part of page 222.

to strike the material to be dissolved from all angles. The cleaners can be supplied with gas, steam, or electric heaters which work automatically at any temperature and are available in sizes having capacities of from 35 to 1000 or more gallons. The flue pipe for the burners is built into the tank and acts as an additional heater for the solution that surrounds it. 76

Smith-Dolan Induction Heater

Electric-Arc, Inc., 152-162 Jelliff Ave., Newark 8, N. J., has redesigned its Model BHD-S Smith-Dolan system induction heater. In the improved design, each half unit is energized independently by its own contactor. Voltage changes are made by a new rotary selector switch, so arranged that no changes are possible when the heater is carrying a load.

The pyrometer and the program controls can be switched to either half of the unit, and it is possible to control both halves as one integrated unit. Thus the machine can be easily used on two separate jobs within the capacity of each half of the induction heater, employing manual control of heat on one unit and automatic control by the pyrometer and program control on the other unit for stress relieving.

This induction heater is mobile and self-contained, with fan-cooled units of 60 and 75 KVA capacities. It has a continuous rated capacity for heating 14- to 18-inch pipe welds to 1350 degrees F. for stress relieving. An output of 125 per cent of rating can be maintained for two hours with safety. The output side is arranged with two independently adjustable units of 1000 amperes, to facilitate heat adjustments on each side of weld.

The heater is 73 3/8 inches wide, 37 inches deep, and 73 3/4 inches high. It weighs approximately 3050 pounds in the 60-KVA size and 3150 pounds in the 75-KVA size. 77

Motch & Merryweather Automatic Forming Machine

The forming of external grooves and shapes, as well as various end machining operations, can be performed on tubular or solid stock by a new automatic machine manufactured by the Motch & Merryweather Machinery Co., 715 Penton Bldg., Cleveland 13, Ohio. This machine is available with single or double, hollow, collet spindles.

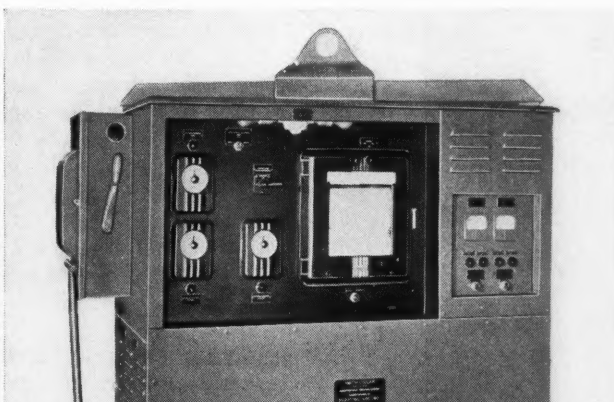
The heavy-duty tool-slides carry the forming and end operation tools, which are advanced and retracted automatically by positive cam operation. When arranged as an automatic bar feed machine, a magazine stock loader can be provided. Hopper loading from the front or rear can also be arranged to meet specific needs.

The entire cycle of this double-spindle machine is actuated mechanically by a single camshaft. The geared drive of the camshaft, contained in the base, has pick-off gears, so that the cycle time can be easily changed to attain the maximum production consistent with good tool life. The spindles are driven by individual V-belt motor drives which are housed in a separate compartment in the machine base. 78

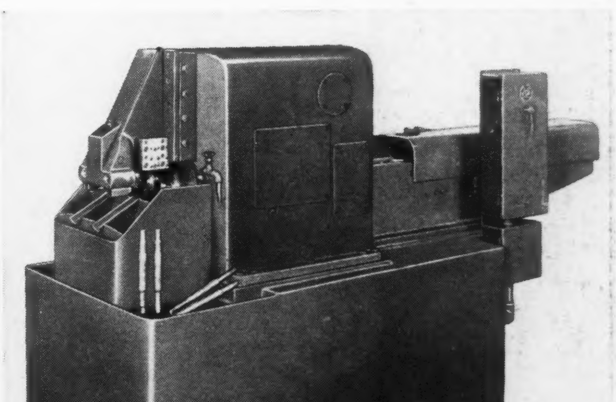
New Blast Cleaning Abrasive

The American Wheelabrator & Equipment Corporation, Mishawaka, Ind., announces a new abrasive known as "Black Beauty," developed to replace silica sand for blast cleaning and finishing operations. It is a non-metallic, silica-free, low-cost, sharp, fast-cutting abrasive which retains its abrading qualities.

Although it has much the same properties as sand, there is no free silica to create an occupational hazard, and it is said to wear two to five times longer than sand and to be less damaging to equipment. It is non-corrosive, stainless, and flows freely; in addition, it does not rust, pack, or harden. Various sizes, graded for any type of work or finish desired, are available. 79



Smith-Dolan induction heater placed on the market by Electric-Arc, Inc.

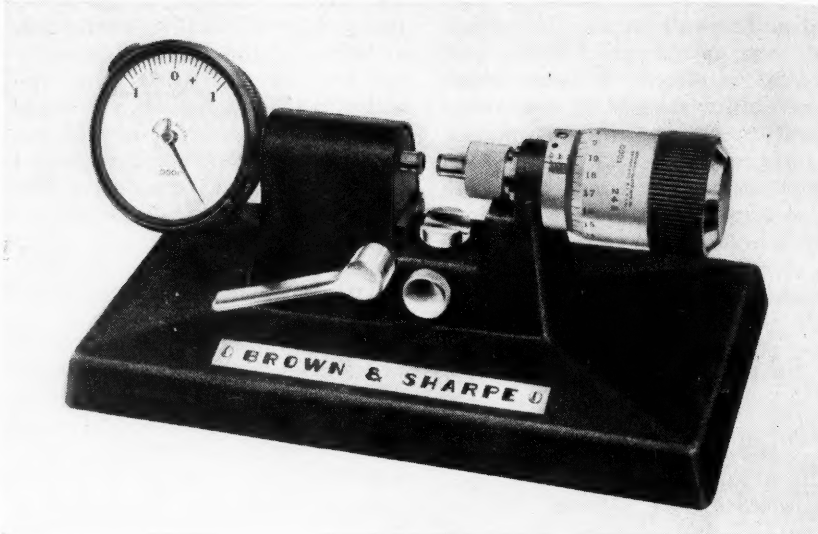


Automatic forming machine brought out by Motch & Merryweather Machinery Co.

To obtain additional information on equipment described on this page, see lower part of page 222.

B & S Indicating Bench Micrometer

The precision indicating bench micrometer illustrated was designed by the Brown & Sharpe Mfg. Co., Providence 1, R. I., to meet the needs of wire manufacturers and others who have to measure small parts accurately. This instrument can be used in three different ways. It measures from 0 to 1/2 inch by 0.0001 inch directly from the micrometer thimble; it can be used as a comparator and set without additional standards for readings to 0.0001 inch taken from the dial gage; and it will measure by 0.0001 inch directly from the dial gage with the micrometer set to the required measurement within the nearest 0.001-inch graduation.



Indicating micrometer made by the Brown & Sharpe Mfg. Co.

The measuring pressure can be adjusted from 8 ounces to 2 pounds, and remains constant when set. The pressure can be set for measuring such resilient materials as rubber, fabric, plastic, etc., as well as metals. The anvils have tungsten-carbide tipped measuring surfaces, and the micrometer threads are precision-ground. The anvil movement is in a straight line, frictionless, and has no bearings or linkages to bind or wear. Measuring surfaces are parallel in all positions. An adjustable work-support permits work of small and large diameters to be centered on measuring surfaces. A retractor lever withdraws the anvil instantly for rapid repeat measurements. Zero adjustment can be made by simply rotating the dial bezel. Rigid stand prevents errors due to "springing." 80

Rockford "Hy-Draulic" Open-Side Shapers with Extra Long Strokes

Because of increasing demands for "Hy-Draulic" open-side shapers with stroke lengths greater than 36 inches, the Rockford Machine Tool Co., Rockford, Ill., is now making this machine with additional stroke lengths of 48, 60, and 72 inches. Longer shaper work and small planer jobs can now be handled on these increased capacity machines.

Open-side shaper with extra long stroke built by Rockford Machine Tool Co.

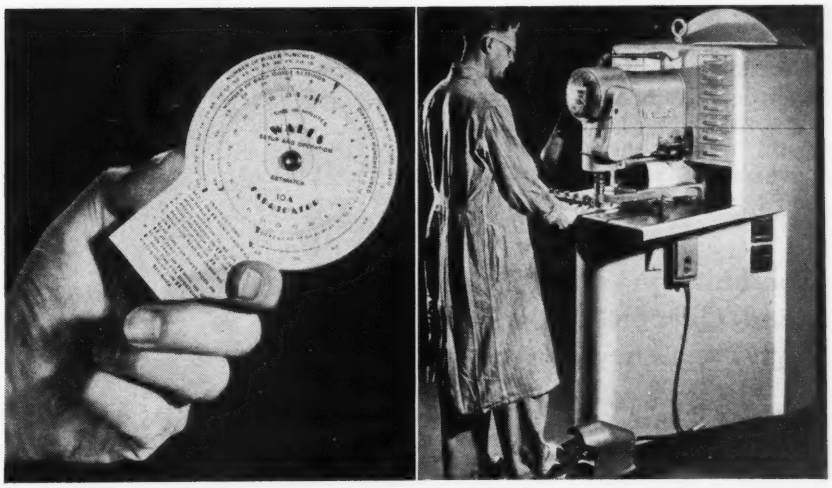
On these new machines, with longer table lengths, the driving motor is mounted on the side of the bed directly behind the column to save floor space. The complete line will accommodate work 24 inches high, 30 inches wide, and 36, 48, 60, and 72 inches long.

The work-table is of box-section type, supported by a double-length bed. The column has a heavy cross-section, and supports an adjustable cross-rail anchored to the column by a triangular rail brace. The cross-rail is adjustable manually, although power elevation can be provided if required.

The "Hy-Draulic" drive and feeds provide a continuous range of cutting speed and feed changes, as well as quick reversal and fast table returns. The absence of gears and racks provides a smooth, uninterrupted finish on the work. Because the few moving parts are submerged in oil, wear is reduced to a minimum. The cushioning effect of oil pressures also tends to increase the life between grinds of the cutting tool. 81

To obtain additional information on equipment described on this page, see lower part of page 222.

Time-Estimating Slide-Rule for Work Performed on Wales "Fabricators"



(Left) New Wales time-estimating slide-rule. (Right) Wales "Fabricator" developed for rapid notching, punching, and nibbling operations on sheet metal

A slide-rule has been made available by the Wales-Strippit Corporation, 345 Payne Ave., North Tonawanda, N. Y., for estimating the cost and machining time for operations performed on Wales "Fabricators." This device makes it possible to calculate, in a few seconds, the time and cost of each part and of the complete production run, whether the part is in the engineering, planning, or production stage.

The time factors incorporated in the slide-rule were determined by extensive time studies covering a wide range of sheet-metal parts. These factors are based on results obtained by average press operators.

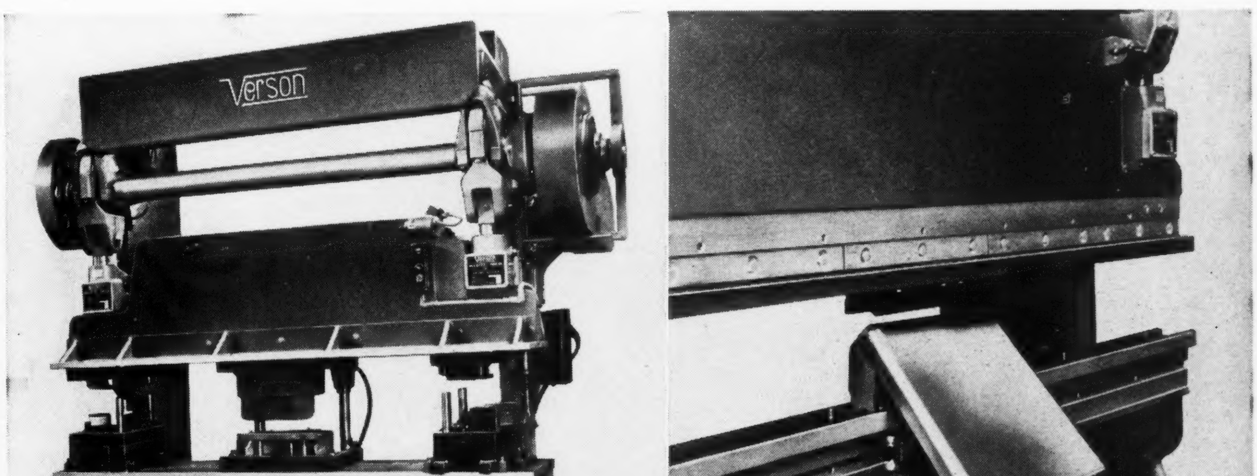
The Wales "Fabricator," shown at the right in the illustration, performs punching, notching, and nibbling operations. The new "Hydra-New-Matic" drive of this machine is said to practically eliminate vibration and noise. 82

Verson Press Brakes Equipped for Forming Flanged Panels with Ball-Shaped Corners

The Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill., has developed tool equipment that makes it possible to form flanged metal panels with ball-shaped corners in standard press brakes at savings in production costs said to range from 30 to 50 cents per panel. Additional advantages claimed are improved appearance of product, minimum spoilage, elimination of corner welding and finishing operations, and reduced handling.

Operations start with a square blank. The standard Verson intermediate press brake shown at the left in the illustration is equipped with dies for performing the first three operations on ball corners. The die at the right trims two of the corners in four strokes preparatory to ball forming; the center die draws the corner in four strokes; and the die at the left trims surplus material from the corners.

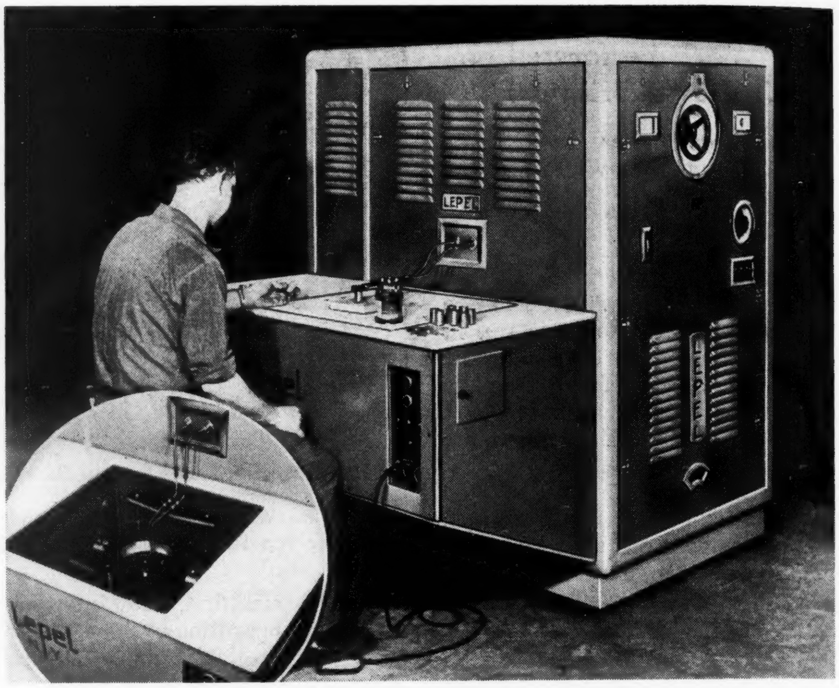
The standard intermediate press brake shown in the view at the right is equipped with a restrike die for forming the side flanges.



(Left) Standard Verson intermediate press brake equipped with dies for performing first three operations on panels with ball-shaped corners. (Right) Verson intermediate press equipped with a restrike die for forming the side flanges of the panels

To obtain additional information on equipment described on this page, see lower part of page 222.

This die consists of a set of master ends and filler blocks. The master ends can be expanded any required distance within the capacity of the brake by placing the filler blocks between the ends. Thus a ball-cornered panel can be completed in only two handlings.....83



Lepel high-frequency converter with combination work-table and quench tank attached. (Inset) Cover removed to show sink with Lepel "Roto" heating and quenching unit

Combination Work-Table and Quench Tank for High-Frequency Converters

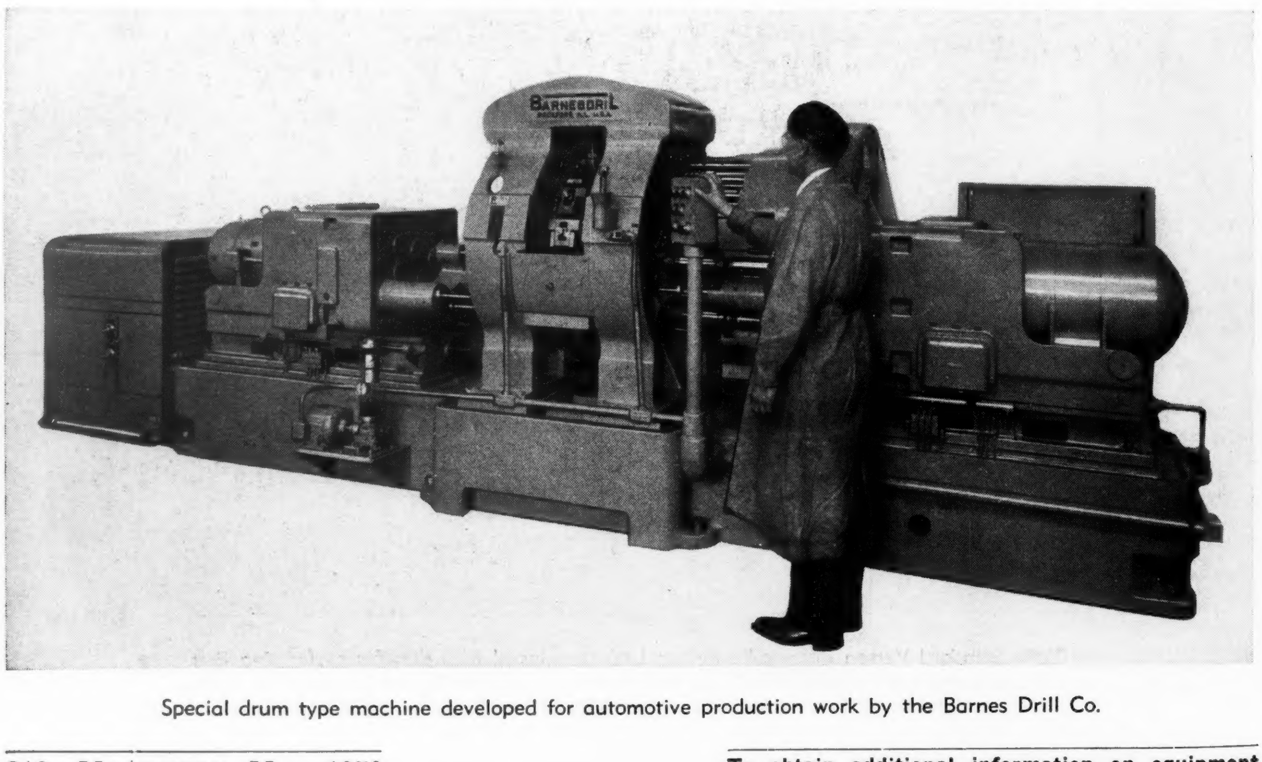
Lepel High Frequency Laboratories, Inc., 39 W. 60th St., New York City, has brought out a combination work-table and quench tank that can be easily attached to the company's vacuum-tube or spark-gap converters. With the sink cover on, this combination unit forms a handy work-table, 29 by 56 inches in size, for mounting work coils and fixtures.

The center portion of the table top can be removed to uncover a brass or stainless steel quench tank 24 by 24 by 18 inches, fed by a 1-inch water line with solenoid control. The tank will also accommodate the Lepel "Roto" heating and quenching unit, designed for the hardening of gears, blanks, etc. Heating and quenching cycles are controlled by a three-circuit timer, operated by push-button or foot-switch..........84

Barnesdril Special Drum Type Machine

Twenty-two operations are performed on a water-pump body in one set-up on a high-production drum type machine recently developed for a prominent automotive manufacturer by the Barnes Drill Co., 820 Chestnut St., Rockford, Ill. The machine is equipped with two opposed hydraulic units having special heads, and a seventeen-station indexing drum, 27 inches in diameter.

One head of the machine is arranged with twenty-five spindles, and the other with five spindles. The unit with the twenty-five-spindle head is powered by a 25-H.P. driving motor and a 3-H.P. hydraulic motor. The unit with

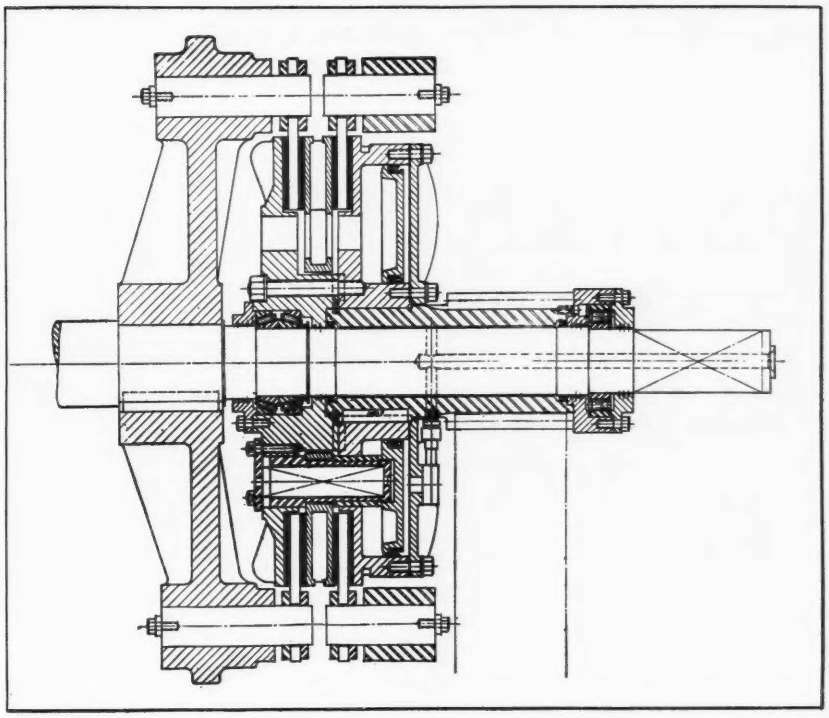


Special drum type machine developed for automotive production work by the Barnes Drill Co.

To obtain additional information on equipment described on this page, see lower part of page 222.

the five-spindle head is powered by a 15-H.P. driving motor and a 2-H.P. hydraulic motor.

The operations consist of drilling, reaming, facing, boring, chamfering, and hollow-milling. In this cycle of operations, twelve holes and four surfaces are machined at a production rate of ninety pieces per hour. The machine controls are interlocked. 85



Cross-sectional view showing construction of pneumatic friction clutch developed for Bliss presses

Bliss Pneumatic Friction Clutch

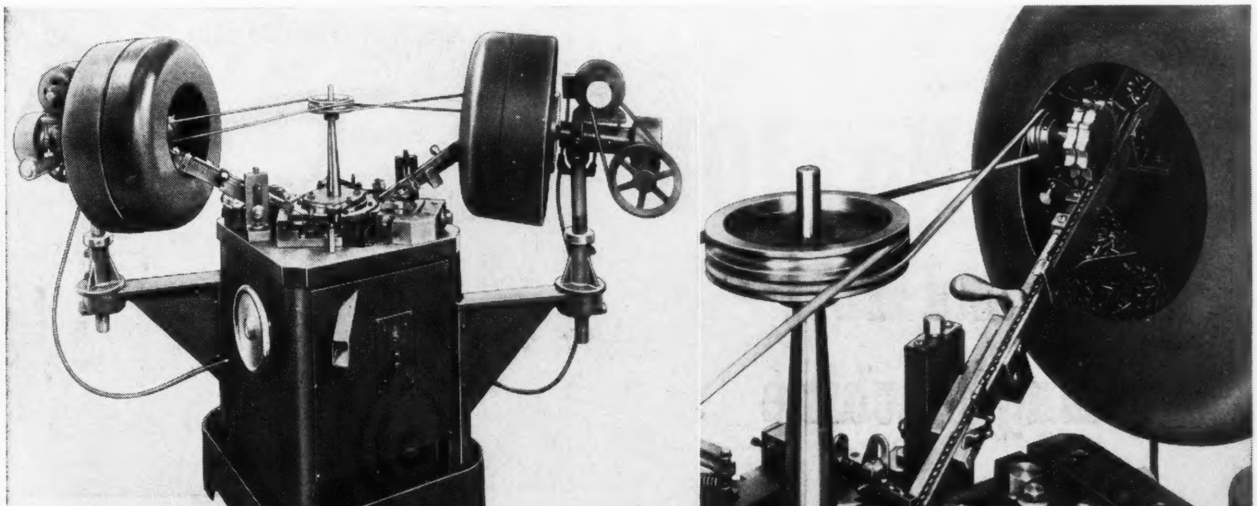
A pneumatic friction clutch designed especially as a replacement for mechanical friction clutches on presses has been developed by the E. W. Bliss Co., 1420 Hastings St., Toledo 7, Ohio. The safety and control features of the electrical system of this new Type L clutch include palm buttons for selectively stopping the press at various positions of stroke. This feature, in addition to being an operating convenience, makes possible more working strokes per day on jobs requiring the clutch to be engaged for each stroke. Inching and single stroking can also be accomplished more conveniently through the electrical control system.

The Type L clutch can be installed on presses in the field without disturbing the existing clutch-shaft support bearings or the flywheel and its drive. It can be used with or without anti-friction drive-shaft support bearings. Springs, disks, and linings are interchangeable with similar clutches supplied on new equipment by the company.

Brake and clutch have automatic lubrication, and are self-adjusting throughout the life of the linings. Linings can be replaced in a matter of minutes without removing the clutch or drive-shaft assembly from the press. 86

Prutton "Rollmaster" Thread-Rolling Machine with "Adjustomatic" Feeding Barrels

The latest addition to the line of high-production automatic thread-rolling equipment manufactured by the D. H. Prutton Machinery & Tool Co., 5295 W. 130th St., Cleveland, Ohio, is the No. 120 "Rollmaster" here illustrated, which is equipped with two automatic feeding barrels. This machine is designed to roll thread



"Rollmaster" thread-rolling machine equipped with new "Adjustomatic" feeding barrels

To obtain additional information on equipment described on this page, see lower part of page 222.

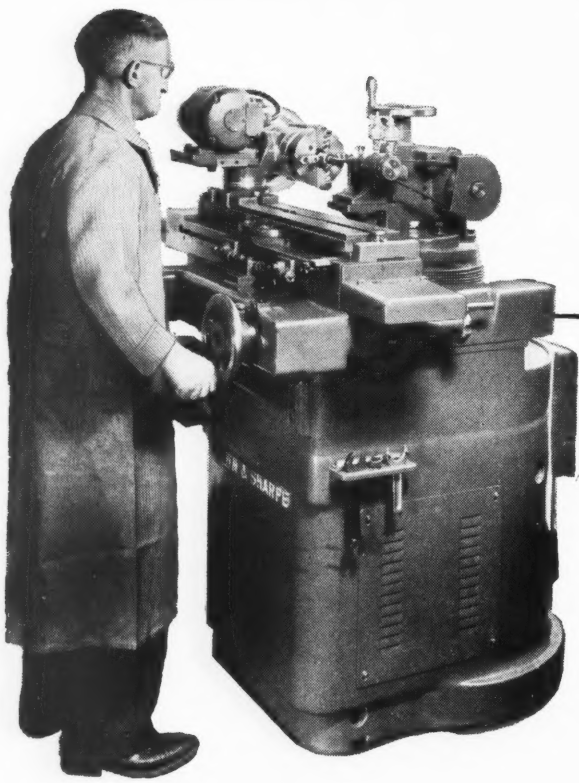
A New Machine

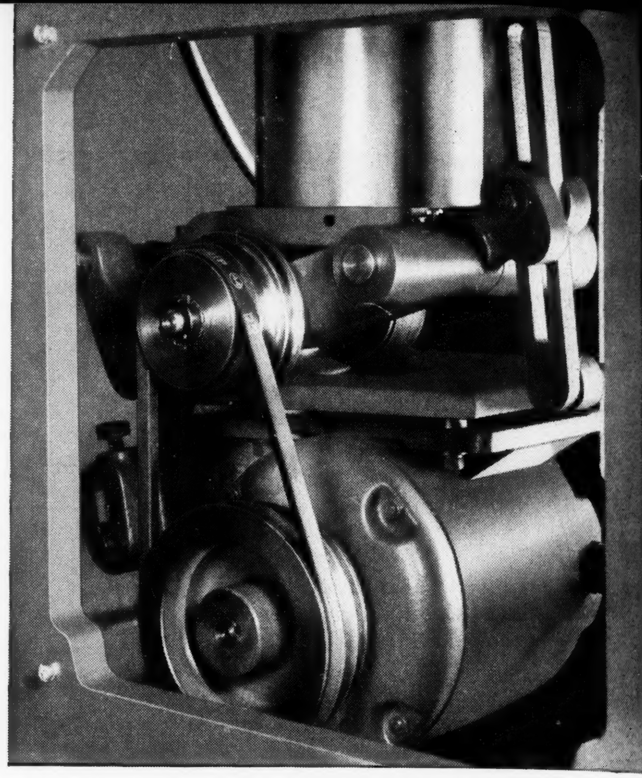
with

UNIVERSAL

or Plain

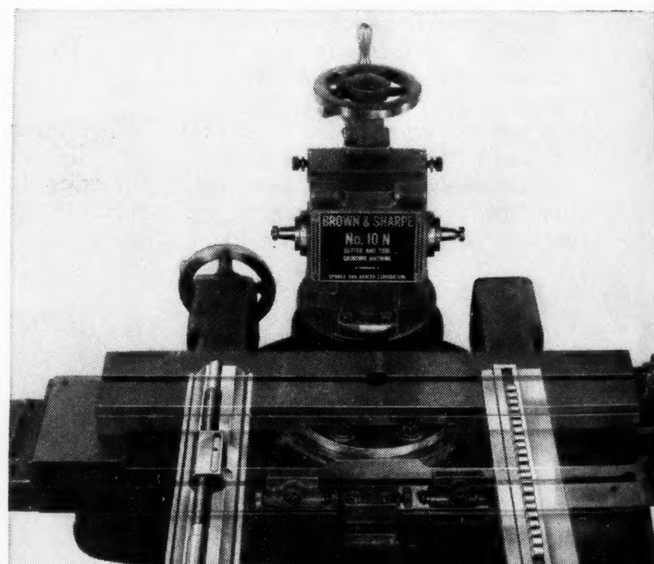
Equipment





Three rates of spindle speed provided by stepped sheaves and V belt shown here. ¾ H.P. motor and mechanism are mounted on lower end of spindle column in base of machine.

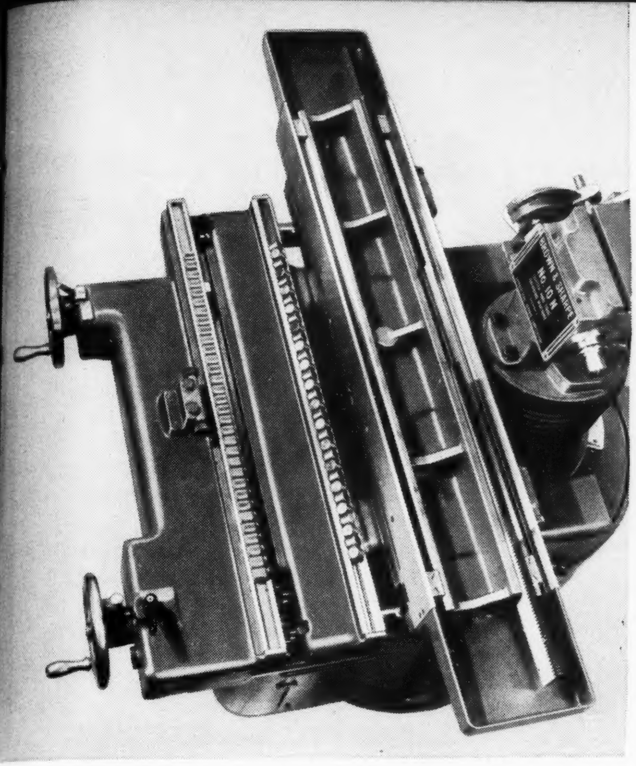
Smooth, non-cramping carriage movement is assured by precision-ground rollers on flat way together with cross feed screw located directly above V-way.



The New No. 10N

Cutter and Tool Grinding Machine

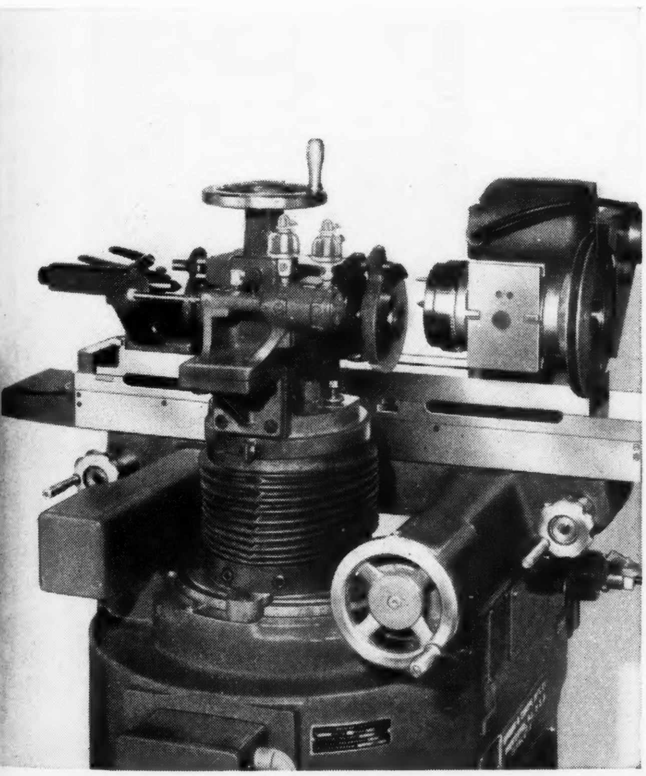
BROWN &



Easy, accurate table movement
is made possible by this unique
arrangement of precision-ground rolls.

end

Conveniently placed controls make operation
of machine equally easy from front-of-table,
right-rear-of-table (as illustrated)
or left-rear-of-table.



Back up better PRODUCTION equipment with this modern TOOLROOM equipment

If faster production through the use of modern production machines is putting a heavier burden on your toolroom, here's a new way to offset it. The super-versatile No. 10 N Cutter & Tool Grinding Machine with Universal Equipment is especially designed for rapid, accurate cutter sharpening and miscellaneous toolroom work.

UNIVERSAL EQUIPMENT gives broad use

Where toolroom grinding involves a wide variety of jobs — light external and internal cylindrical grinding, surface grinding, etc., as well as routine sharpening — the No. 10 N with Universal Equipment offers unmatched advantages . . . a money-saver on either toolroom or production work. It includes — revolving spindle headstock equipment, internal grinding fixture, formed cutter sharpening attachment (in-feed type) and a surface grinding vise. Where toolroom grinding involves only tool and cutter sharpening, the No. 10 N with Plain Equipment may completely meet the demands of your modern production machines. The same, simple, basic design is common to both.

Designed to Save Waste Motion

Notice the following Brown & Sharpe features that mean so much to operating efficiency . . . handwheels conveniently located for fast, easy operation . . . elevating handwheel of wheel spindle is at convenient eye level . . . internal grinding fixture may be left permanently mounted (does not interfere with cylindrical or cutter grinding). These and other important features, including useful attachments, are fully described in a NEW BULLETIN. Send for your copy. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

SHARPE BS

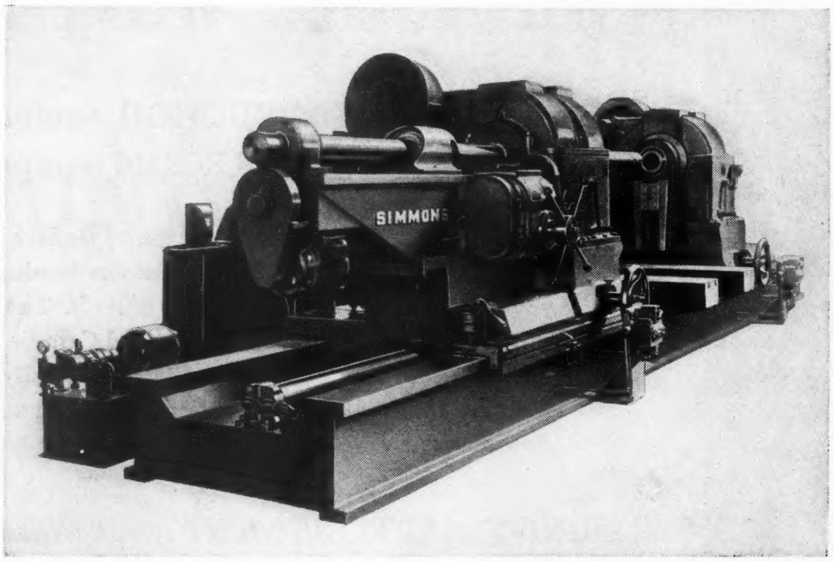


Fig. 1. Simmons double-unit horizontal boring and facing machine with fixed cross-tables

bide tooling, and has a range of bar speeds of 3 to 150 R.P.M., and bar feeds from 0.0005 to 0.500 inch per revolution. It has a 40-H.P. motor drive with precision anti-friction bearings.

An interesting development is the continuous-feed facing head designed for these machines, which dispenses with the star feed formerly used on facing heads and allows the full application of high-speed facing with carbide tools. The standard length of the boring-bar is 17 feet, and the travel in one setting is 60 inches. Bed lengths and widths can be supplied to meet requirements. 88

lengths up to 2 1/8 inches on bolts up to 1/4 inch in diameter. It has a production speed of 25,000 pieces per hour, and will hold threads to a Class 3 tolerance or better. This machine, like the smaller No. 100 "Rollmaster," is of the two-station, rotary type, which permits rolling two head types and thread lengths simultaneously.

The "Adjustomatic" feeding barrel unit is now being marketed separately. This unit will feed fifteen thousand 1/4-inch bolts per hour. Complete adjustability for height, angle, speed, and spill make this feeding barrel adaptable for feeding parts in a large variety of densities, weights, designs, and sizes. 87

Simmons Horizontal Boring and Facing Machine

A horizontal boring and facing machine with a 6-inch boring-bar, which is adapted for all types of cylindrical work, has been developed by the Simmons Machine Tool Corporation, Albany, N. Y. This machine is especially designed for use in plants manufacturing Diesel engines, large turbines, refrigerators, and any other products requiring accurate boring of large deep holes.

In addition to the bar feed in the head, the entire boring and facing unit of the machine can be moved hydraulically along the bed. The new machine is designed primarily to take advantage of car-

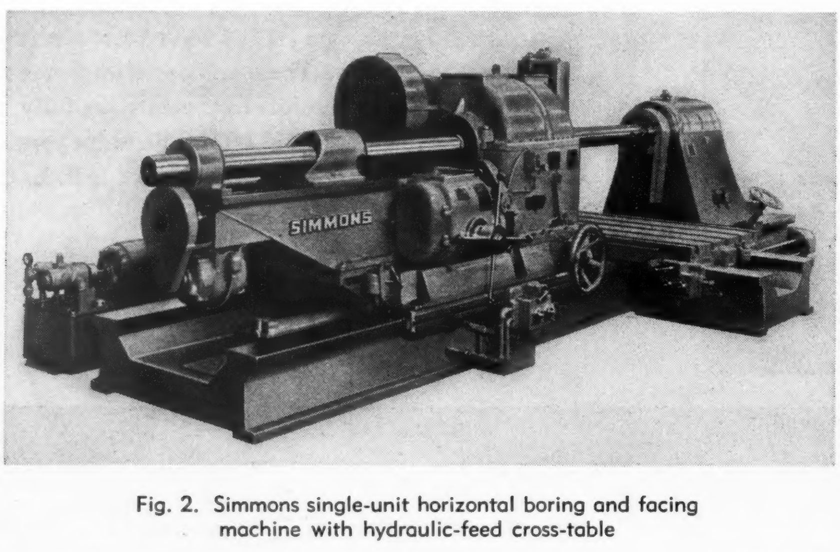


Fig. 2. Simmons single-unit horizontal boring and facing machine with hydraulic-feed cross-table

High-speed gear-tooth burring and chamfering machine built by the Sheffield Corporation

Sheffield High-Speed Gear-Tooth Burring and Chamfering Machine

A new high-speed precision gear-tooth burring and chamfering machine designed for the economical handling of various types of gears is announced by the Sheffield Corporation, Dayton 1, Ohio. This Model 380 machine is available with either single or multiple stations for burring and chamfering spur or helical gears, as well as multi-start worms, up to 7 inches in diameter. It will operate continuously at a speed

To obtain additional information on equipment described on this page, see lower part of page 222.

of 300 teeth per minute, or intermittently when equipped with an automatic work cycle that stops the machine after the part has been completely burred.

Low-cost tooling and long-life cutters are among the advantages claimed for this machine. The cutters are sharpened by grinding the face, thus reducing cutter sharpening costs. One or both flanks of the tooth form, including the root, can be chamfered at each stroke of the cutter. The indexing and cutter motion control unit are enclosed and run in an oil bath. Other features include anti-friction bearings, adjustable drive gear, and rapid timing device. 89

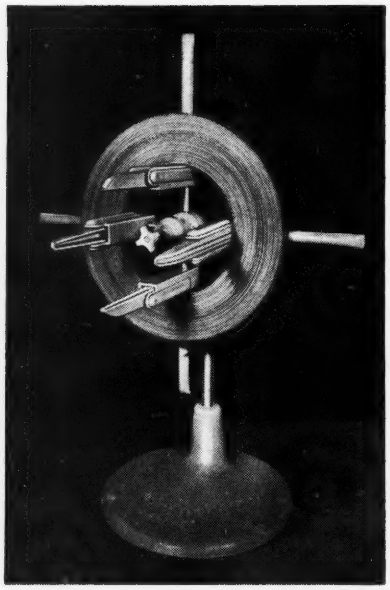


Fig. 1. Stock reel with holding forks folded down to facilitate loading

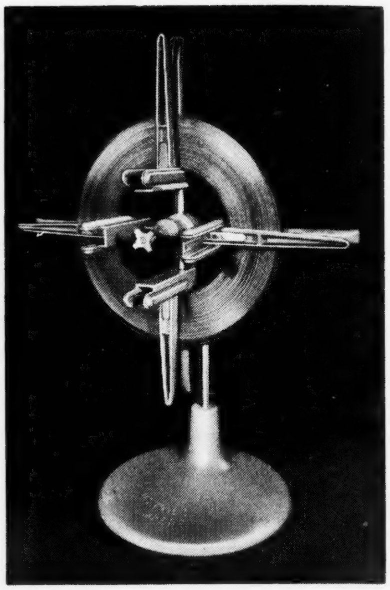


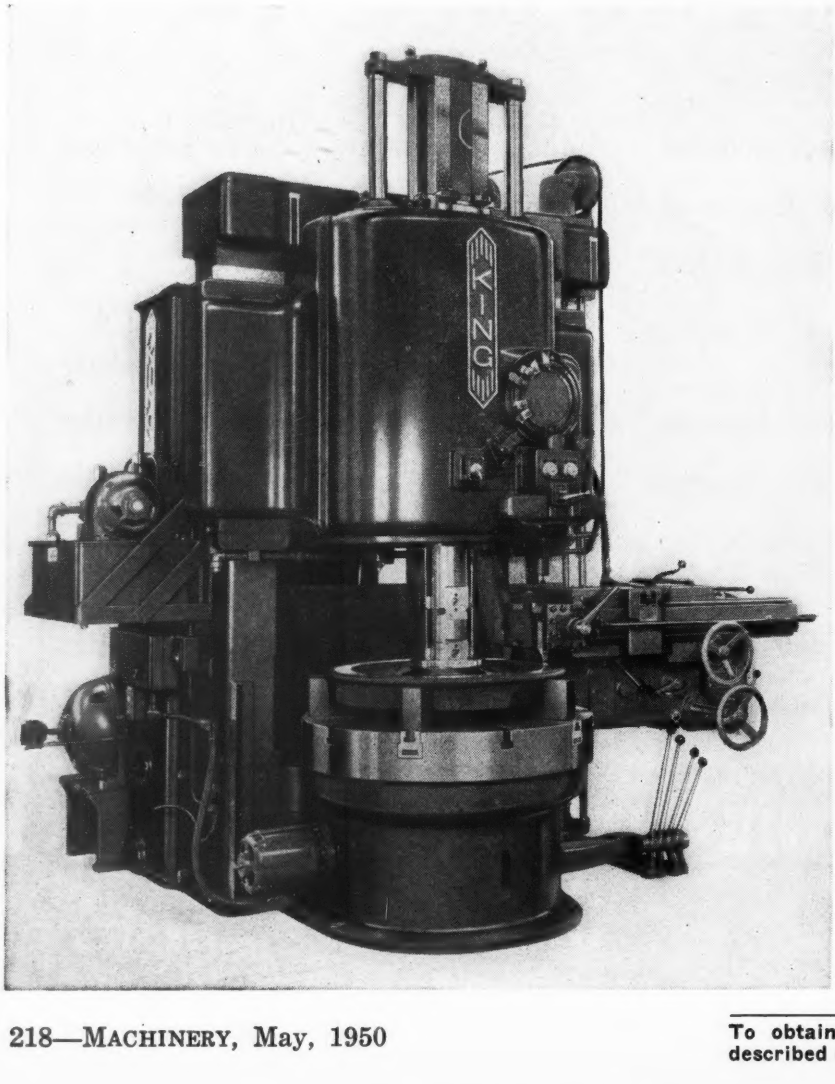
Fig. 2. Stock reel shown in Fig. 1 with holding forks raised

Plain Coil Stock Reel with Collapsible Holding Forks

The U. S. Tool Company, Inc., Ampere (East Orange), N. J., has recently added a new stock reel to its line of automatic press-room equipment. This reel, known as Model SRF-654, is designed to save users' time in loading or unloading coils. Ordinarily, it is necessary for the operator to remove each individual fork or arm on the reel in order to mount a new coil of material. With this new plain stock reel, the operator folds the forks down, as shown in Fig. 1, to allow the coil to be slipped into place. The collapsible forks are then snapped up into position as shown in Fig. 2.

Construction features of the new reel include quick clamping mechanism on forks; adjustable to any angle to suit press; needle and thrust bearings to permit free rotation of spindle; drag to provide desired amount of tension; adjustable core diameters; and rigid floorstand with offset base.

Stock up to 6 inches in width and coils with inside diameter from 8 1/8 to 28 inches and outside diameter from 34 to 54 inches can be handled. The reel weighs 300 pounds. 90



King special machine developed for boring and facing Diesel locomotive wheels

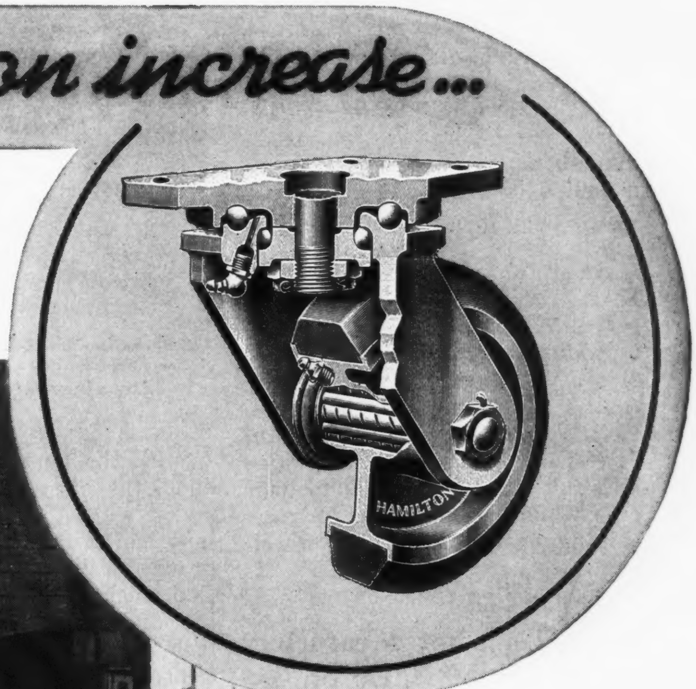
King Diesel Locomotive Wheel Boring Machine

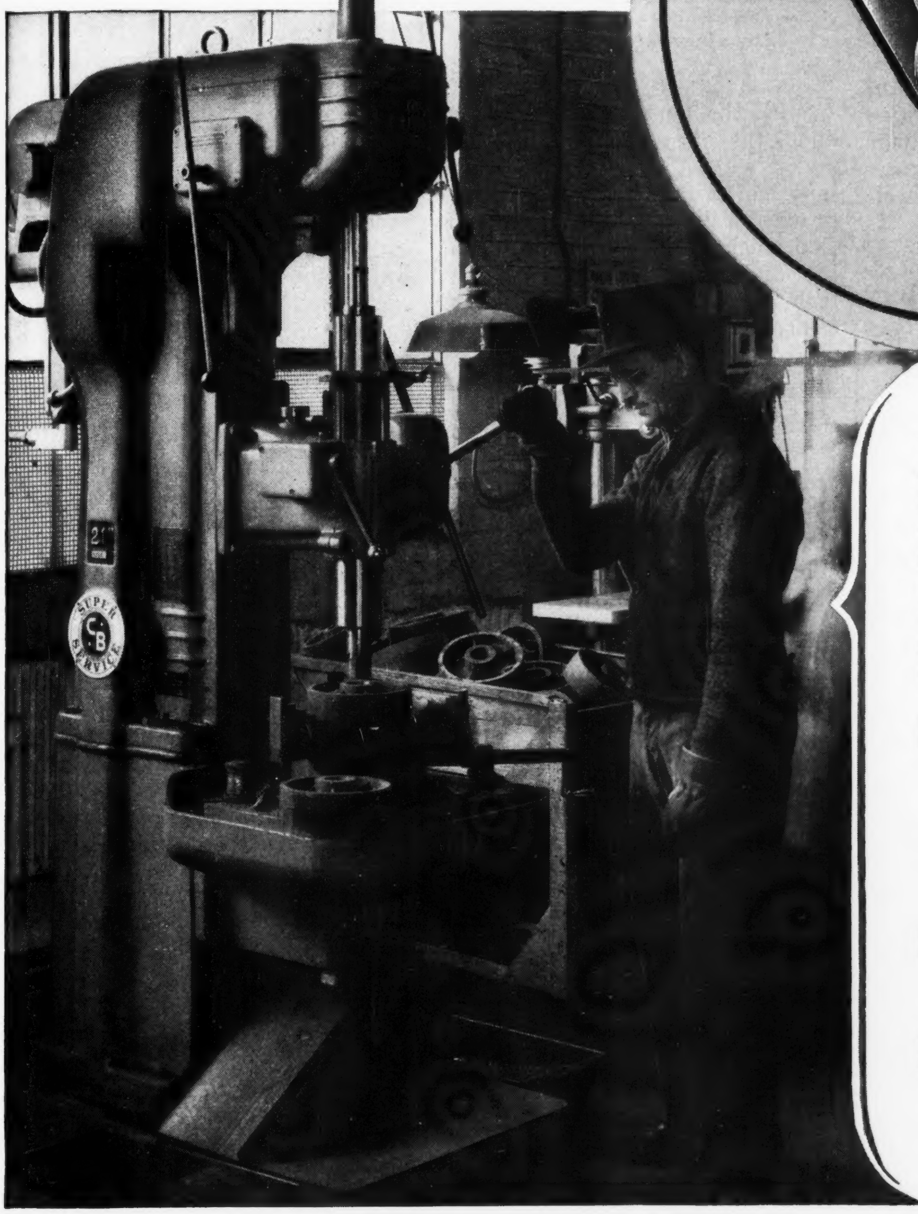
American Steel Foundries, King Machine Tool Division, Cincinnati 29, Ohio, has developed a special machine for boring and facing Diesel locomotive wheels. The new machine has a massive fixed rail, designed to provide exceptional rigidity for carrying the over-sized boring ram and hydraulic feed cylinders. The ram is of square construction, and permits accurate alignment and easy

To obtain additional information on equipment described on this page, see lower part of page 222.

New *production increase...*

The Hamilton Caster and Manufacturing Company, Hamilton, Ohio chose a 21" Direct Drive HIGH PRODUCTION Super Service Upright Metal Drilling Machine to increase production.





This machine is opening up cored holes (15/16" diameter X 3-¼" deep) in rubber tired shop truck wheels. The accuracy of this operation is held to such limits as to permit the insertion of bearing outer races. Savings are now being realized in;

PRODUCTION Increases
LABOR COST Reductions
POWER COST Reductions
FLOOR SPACE Reductions

Good judgment in selecting the proper machines, tools, and fixtures will consistently produce the best manufacturing results. Our CUSTOMER PRODUCTION ENGINEERING SERVICE in the metal drilling field represents the collective experience of many years (since 1874). Make your problems ours - - let us show you a profitable Radial or Upright Drill production application. Your most urgent production problems warrant our immediate attention.

Equal Efficiency of Every Unit Makes the Balanced Machine

THE CINCINNATI BICKFORD TOOL CO.
RADIAL AND UPRIGHT — SUPER C B SERVICE — DRILLING MACHINES

Radials 7½" dia. col., 2½' arm, to 26" dia. col., 12' arm.
General purpose Uprights, 21" to 28" sizes.
Production Uprights, 21" to 28"
Jig Borers, Portable Horizontals, Spacing Table Machines.

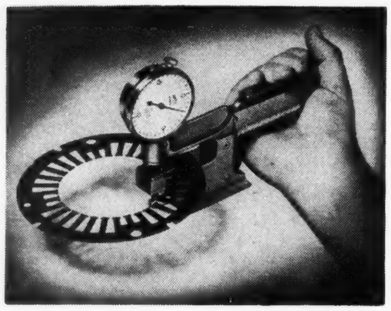
THE CINCINNATI BICKFORD TOOL CO. **Cincinnati 9, Ohio**

adjustment by four large gibs. The fully automatic ram cycle can be set for rapid traverse to the work, rough-bore at one feed, finish-bore at another feed, form a radius at another feed, dwell, and rapid traverse out of the work.

A special motor-operated chuck holds the wheel securely and serves to speed up the loading and unloading operations. The separate hydraulic power unit for actuating the boring head is located on the side of the machine. An over-sized side-head assembly permits full use of the carbide tooling even while it is extended for machining operations on the wheel hub. 91

Ames Gage for Measuring Height of Burrs on Stampings

The B. C. Ames Co., 27 Ames St., Waltham 54, Mass., has brought out a new gage designated the S-4930 burr gage, which is designed to measure accurately the height of burrs raised on stampings of all materials. As dies and punches wear, a burr is thrown up on the punch side of the stamping, and in many instances this burr causes difficulty in assembling the parts. The new gage is useful in controlling punch and die life by determining when or how often dies and punches must be ground to maintain maximum efficiency. It eliminates the danger of shortening the life of expensive carbide dies unnecessarily by too frequent grinding.



Ames burr measuring gage

With the burr gage, the press hand, the inspector, and the die-maker will all get the same readings and will therefore agree as to when a die should be reground. The amount of burr is shown on the dial to one-half thousandth inch. Quarter thousandths can be easily estimated. 92

New Blanchard Solid Wheel Holder

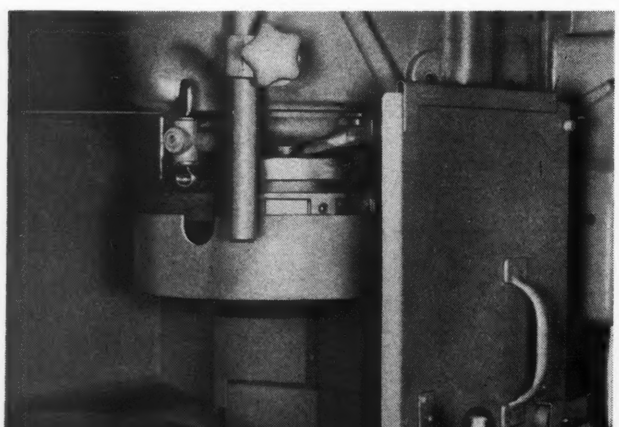
A new holder for cylinder grinding wheels has been announced by the Blanchard Machine Co., 64 State St., Cambridge 39, Mass. This solid wheel holder is now available for the No. 11 and No. 18 Blanchard surface grinders. Specially designed spring clamps, three for the No. 11, and five for the No. 18 machines, hold the wheel securely. These solid wheel holders eliminate the need for "sulphuring" wheels into rings, and enable wheels to be changed in five minutes on the No. 11 and seven minutes on the No. 18 machine. 93

Reed Machine for Offset Forming of Sheets to be Joined by Welding

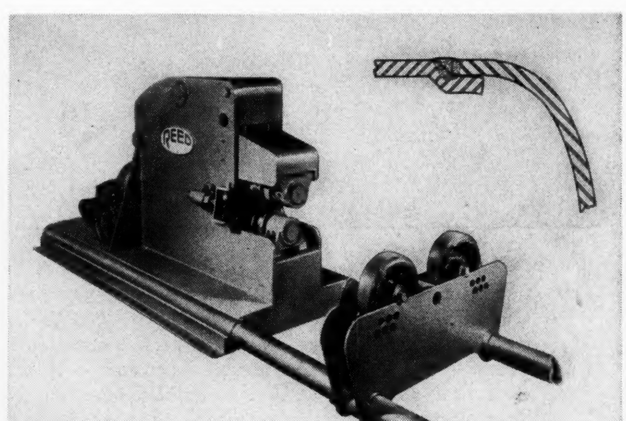
The Reed Engineering Co., 1003-17 W. Fairview Ave., Carthage, Mo., has recently developed an offset process of preparing metal sheets for welding. With sheets prepared in this way, circumferential seams on tanks and cylindrical shapes up to 7/16 inch thick can be welded automatically without back-up bars or manual back-up welds. The use of this offset joint has been approved by the A.S.M.E. Boiler Code.

The machine used in the new process produces an offset at the ends of the shell section over which the tank heads or other shell sections can be fitted for automatic welding. A typical welded joint detail is shown in the insert in the illustration. The offset portion serves as the "back-up." In the offset process, the shell is made more nearly round.

The new Model M-4 offset forming machine is equipped with hardened steel forming rolls. Hydraulic power is utilized for the offsetting pressure. With standard forming rolls, the machine can handle material ranging from 3/16 to 7/16 inch in thickness. The minimum diameter that can be handled is 24 inches, whereas the maximum diameter depends on the rigidity of the shell and material handling equipment available. Approximate floor space requirements for the machine are 4 by 8 feet. Shipping weight of the machine is about 5000 pounds. .. 94



Solid wheel holder for surface grinders brought out by the Blanchard Machine Co.



Machine for offset forming of sheets to be welded made by Reed Engineering Co.

To obtain additional information on equipment described on this page, see lower part of page 222.

High-Intensity Illuminating Unit for J & L Comparators

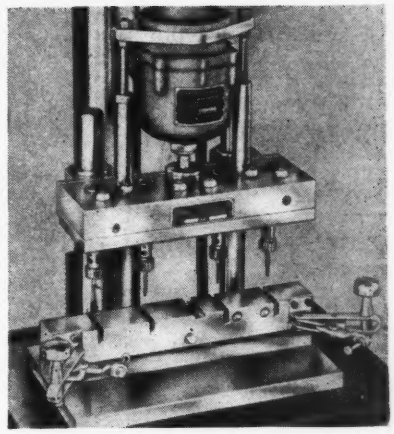
High-intensity illuminating units are now being supplied on Model BC-14, PC-14, and PC-30 optical comparators manufactured by the Jones & Lamson Machine Co., Springfield, Vt. The new unit provides increased screen illumination, particularly at high magnifications. It increases the sharpness of shadow outlines, and enables highly accurate readings to be obtained with less effort and eye strain.

The upper portion of the unit carries a 10-volt bulb, a condensing lens, and a colored filter, while the lower box section houses a small centrifugal type electrically driven blower. The illustration shows the method of clamping the unit to the base. The cooling unit operates when the lamp switch is turned on, and draws a constant stream of air through the port at the top of the lamp house. This air stream passes down around the bulb and through the lamp-house base in the blower, from which it is exhausted through the screened vent in the side of the lower housing. This cooling system serves to keep the entire lamp assembly at a constant normal temperature. 95

Kenco Open-Back Inclinable Punch Press

A 4-ton open-back, inclinable punch press, of bench design, is a recent product of the Kenco Mfg. Co., 5211 Telegraph Road, Los Angeles 22, Calif. The press is of massive design for its capacity. It has a large 7- by 10-inch bolster plate, which permits use of standard die sets; large hardened and ground, adjustable, V-type ram guides on each side of frame; over-sized ram area; extra heavy-duty ram, designed to facilitate setting up; and one-piece, ground crankshaft with extra heavy connecting-rod.

The new press has a positive, single trip mechanism, which is adjustable for wear and is instantly convertible from single trip to "repeat" without stopping the motor. A hardened and ground sleeve in the flywheel minimizes wear and noise. An adjustable motor bracket relieves strain on the motor. 96

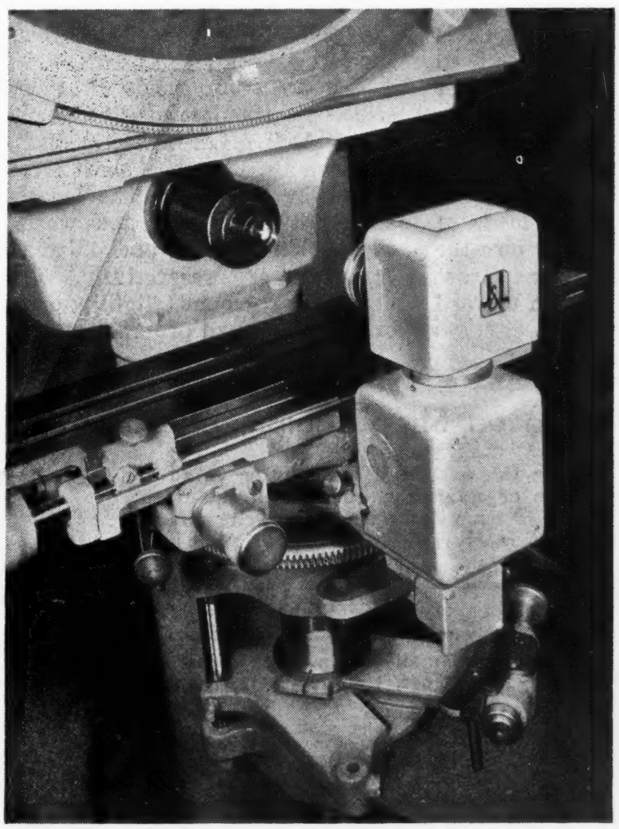


"Multi-Tapper" brought out by the Charles L. Jarvis Co.

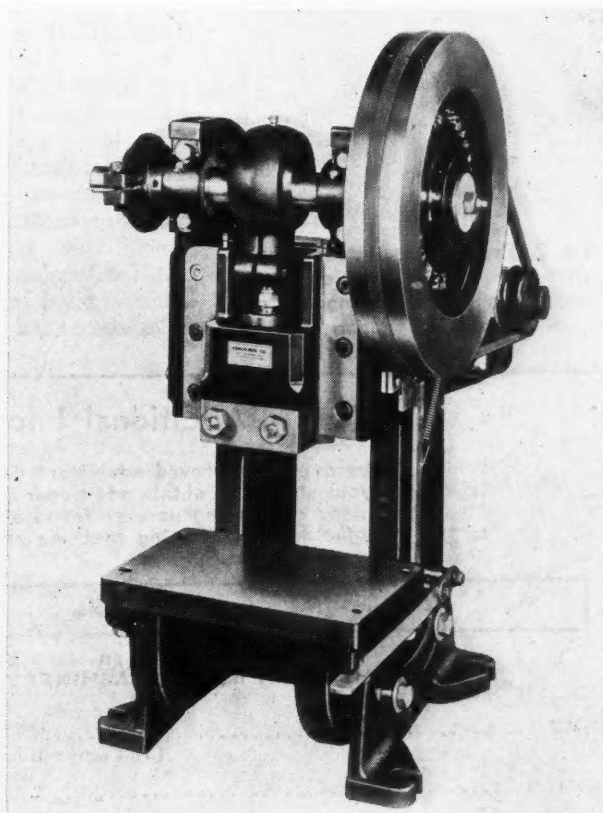
Jarvis "Multi-Tapper"

The Charles L. Jarvis Co., Middletown, Conn., has brought out a new "Multi-Tapper" for multiple tapping and drilling in mass production lines. A silent roller chain arrangement is employed to transmit power from the "Torquomatic" drive unit.

The chain is designed to withstand constant friction, and can readily absorb the shock loads imposed by the continuous reversing action. Less wear on gears, quiet



Jones & Lamson comparator equipped with new illuminating unit



Open-back inclinable punch press made by the Kenco Mfg. Co.

To obtain additional information on equipment described on this page, see lower part of page 222.

operation, and increased production at lower costs are advantages claimed for this tapper. The number of spindles is limited only by the size of the tap or drill and the work. 97

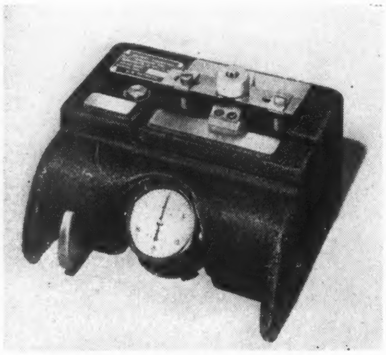


Fig. 1. Bryant internal thread gage

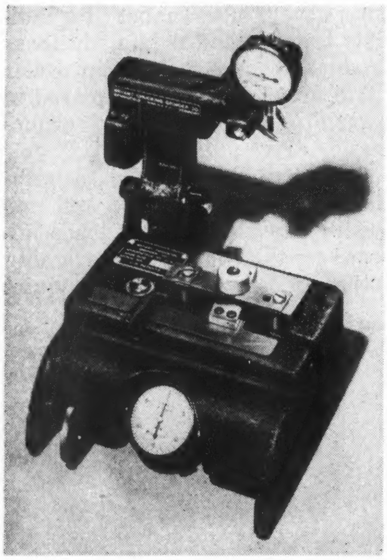


Fig. 2. Bryant internal thread gage with attachment for checking squareness of face swung out of operating position

Bryant Thread Gage

The Bryant Chucking Grinder Co., Springfield, Vt., has brought out a new gage designed to reduce inspection time and permit checking threaded parts with a high degree of accuracy. This gage employs interchangeable segments, so that a wide range of internally or externally threaded parts can be checked on the same basic gage. Internally threaded parts can be checked for fit and inspected for roundness in one operation at the rate of 0.07 minute per thread. Operator fatigue is low because only the part is handled.

This No. 11 gage can be furnished with a new attachment for checking face run-out in relation to the thread axis. Other features include a universal work-holder for internal parts and adaptability for checking additional surfaces in relation to the thread. 98

Cleveland Worm-Gear Speed Reducers

The Cleveland Worm & Gear Co., 3276 E. 80th St., Cleveland 4, Ohio, has announced two new vertical speed reducers designated Type NU (Fig. 1) and Type ND (Fig. 2). These units have been designed to meet the most severe requirements. Gear-shafts of large diameter are supported by heavy tapered roller bearings spaced to provide the capacity necessary for carrying external radial loads of appreciable magnitude on the shaft extensions, as well as thrust loads applied in either an upward or a downward direction.

Fig. 1. Cleveland Type NU speed reducer with vertical shaft extending from top of housing

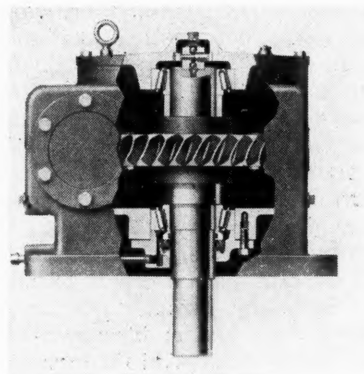


Fig. 2. Cleveland Type ND speed reducer with vertical shaft extending below base of housing

The units are made in seven sizes, the smallest size having a worm-shaft 1 1/8 inches in diameter and a worm-wheel shaft 1 7/8 inches in diameter. The largest size unit has worm and worm-wheel shafts 2 1/2 and 4 inches in diameter, respectively. The shafts are ground slightly oversize for standard press fits. 99

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described in this section is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in May, 1950, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on blank below. Detach and mail within three months of the date of this issue to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

NAME...**POSITION OR TITLE**.................................

[This service is for those in charge of shop and engineering work in manufacturing plants.]

FIRM...

BUSINESS ADDRESS..

CITY...**STATE**...

New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 228 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the May, 1950, Number of MACHINERY

Power-Driven Machine Tools and Woodworking Machines

POWER TOOL DIVISION, ROCKWELL MFG. CO., Milwaukee 1, Wis., has brought out a new technical publication known as the *Power Tool Journal,* which will be distributed six times a year. The publication will be devoted to applications of Delta-Milwaukee machine tools, Crescent woodworking machines, and Delta multiplex radial-arm saws. Those interested can receive copies by sending their name, title, company name, and company address to Power Tool Division, Rockwell Mfg. Co.

Carbide-Tipped Tools

WHITMAN & BARNES, Plymouth, Mich. Catalogue 104, listing carbide-tipped drills, reamers, and countersinks. Suggestions on the use of these tools, as well as grinding recommendations and tables of cutting speeds, are included. Copies can be obtained if requested on a business letter-head addressed to the company.

Aluminum Paint

ALUMINUM CO. OF AMERICA, 661 Gulf Bldg., Pittsburgh 19, Pa. Thirty-two-page bulletin on aluminum paint for industrial use, explaining how to use such paint to best advantage on different kinds of surfaces. Copies can be obtained by writing directly to the company on a business letterhead.

Tool-Steel Selector

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York 17, N. Y., is distributing a tool steel selector, in the form of a circular slide-rule, which is based on selection of steel according to application. By setting the device to one of the six general classes of applications, such as cutting tools, and to the appropriate sub-division (for example, general-purpose), the proper grade of steel can be read in the cut-out. A choice of two steels is given for each sub-division, according to the characteristics (depth of hardening and machinability) and required heat-treatment, which are shown in corresponding cut-outs. Thus the steel most suitable for the desired use can be easily selected. 1

Slitting Machinery

YODER CO., Department 5504, Cleveland 2, Ohio. Publication entitled "Multiple Rotary Slitting Lines," containing 76 pages of information on the design, selection, and operation of multiple rotary slitters and slitting lines for coils and sheets. Production rates, general data on the cost of equipment and operating costs, advantages, and economies of this type of machinery are discussed, together with the training of operators and other pertinent subjects. Specifications and capacity tables are included. 2

Carbide Header Dies

CARBOLOY COMPANY, INC., 11147 E. Eight Mile St., Detroit 32, Mich. Bulletin (Supplement D-4) listing rough-cored carbide header-die nibs, which are carried in stock in seventeen different sizes. A leaflet is also available from the company on the assembly, finishing, and maintenance of these die nibs. 3

Airflex Couplings

FALK CORPORATION, Milwaukee 8, Wis. Bulletins 8100 and 8105, describing the redesigned Falk Airflex coupling, especially intended for engine drives and applications involving severe torque fluctuations. Construction features, dimensions, and methods of selection are included. 4

Metal Cleaning Guide

OAKITE PRODUCTS, INC., 126 Thames St., New York 6, N. Y. Booklet containing 44 pages of material on all phases of metal cleaning, including a description of materials, equipment, and procedures for the most effective removal of various types of soils, as well as information on rust prevention, coolants and lubricants, paint stripping methods, etc. 5

Simplified Dimensional Control System

DOW MECHANICAL CORPORATION, Thompsonville, Conn. Catalogue entitled "A Practical Suggestion for Improving Quality and Reducing Cost," explaining in detail the company's system of simplified dimensional control for gaging accurately machined production parts from 1/16 inch to 5 inches in diameter and height. ..6

Lay-Out Fluid

DAYTON ROGERS MFG. CO., 2835 Twelfth Ave., South, Minneapolis 7, Minn. Circular announcing a lay-out fluid for diemakers, patternmakers, machinists, and toolmakers, available in twelve different colors; also suitable as an identification ink for marking various stock materials. 7

Material Stop-Gage

STANDARD IRON & WIRE WORKS, INC., 2930 N. Second St., Min-

neapolis 11, Minn. Leaflet descriptive of the new "Mule" stock or material stop-gage designed to absorb shocks and having a wide application in cutting, shearing, punching, bending, and sawing operations. 8

Magnetic Coolant Separators

BARNES DRILL CO., 820 Chestnut St., Rockford, Ill. Bulletin 3005, descriptive of "BarnesdriL" magnetic coolant separators, including illustrations showing typical installations on a variety of machines. Complete specifications are given for the various sizes. 9

Worm-Gear Speed Reducers

CLEVELAND WORM & GEAR CO., 3276 E. 80th St., Cleveland 4, Ohio. Bulletin 125, describing two new Cleveland vertical speed reducers, especially adapted for agitators and mixers or for use in connection with low-speed spur-gear drives without outboard bearings. 10

Electric Motors and Power Drives

RELIANCE ELECTRIC & ENGINEERING CO., 1077 Ivanhoe Road, Cleveland 10, Ohio. Bulletin entitled, "Your Visit with Reliance," prepared primarily to give customers or visitors a complete picture of the facilities, operations, and products of the company. 11

Material Spraying Pumps

STEWART-WARNER CORPORATION, ALEMITE DIVISION, 1826 Diversey Parkway, Chicago 26, Ill. Pamphlet entitled "Here is Something Really New," describing the spray application of almost all types of materials by the use of the Alemite "Versatal" pump. 12

Heat-Treated Alloy Steels

JOSEPH T. RYERSON & SON, INC., Box 8000-A, Chicago 80, Ill. Bulletin containing engineering data on two heat-treated alloy steels known as "Rycrome" and "Nikrome M," suitable for heavy-duty axles and shafts, gears and pinions, studs, bolts, etc. 13

Lubricants

FISKE BROTHERS REFINING CO., 129 Lockwood St., Newark 5, N. J. Data Book No. 1-50, containing information on lubrication, together with recommendations for selecting the proper lubricant for various types of service. 14

Industrial Radiography

EASTMAN KODAK CO., Rochester 4, N. Y. Catalogue containing information on materials and accessories for industrial radiography, including films for use with X-ray equipment of varying kilovoltage and for specimens of different thickness and density. 15

Design of Threaded Parts

EASTERN MACHINE SCREW CORPORATION, 23-43 Barclay St., New Haven 6, Conn. Bulletin containing an article entitled "Cost Reducing Suggestions on the Design of Threaded Parts for Designers, Draftsmen, Tool Engineers, Operators, etc." 16

Heliarc Welding Equipment

THE LINDE AIR PRODUCTS COMPANY, 30 E. 42nd St., New York 17, N. Y. Folder F-7013A, describing the principal features of Heliarc inert-gas shielded arc-welding equipment, including torches, electrodes, regulators, etc. 17

Precision Levels

PRATT & WHITNEY DIVISION NILES-BEMENT-POND CO., West Hartford 1, Conn. Circular 472-1, descriptive of the Pratt & Whitney 15-inch precision level for insuring accurate machine performance. 18

Machine Tools

HILL ACME CO., 1201 W. 65th St., Cleveland 2, Ohio. Bulletin illustrating typical examples of the grinding machines, shears, threading machines, tapping machines, forging machines, and portable cranes made by the company. 19

Vernier Calipers

GEORGE SCHERR CO., INC., 200 Lafayette St., New York 12, N. Y. Leaflet descriptive of the Mauser precision vernier caliper with improved quick-action cam lock, for outside, inside, and depth measurements. 20

Tool Treating Process

SOL-VEN-ITE LABORATORIES, 3928 Elston Ave., Chicago 18, Ill. Circular describing a new tool treating process known as "Solvenizing"—a secondary hardening process designed to increase the life of high-speed steel tools. 21

Journal Roller Bearings

ORANGE ROLLER BEARING CO., INC., 552 Main St., Orange, N. J. Folder listing dimensions and prices of the Orange line of journal roller bearings, designed for application where radial space is limited. 22

Free-Cutting Steel

JONES & LAUGHLIN STEEL CORPORATION, Pittsburgh 30, Pa. Revised edition of a pamphlet on J & L free-cutting E-steel, containing case histories of results obtained with this new Bessemer screw stock. 23

Electric Control Switch

ARROW-HART & HEGEMAN ELECTRIC CO., 103 Hawthorn St., Hartford 6, Conn. Circular containing engineering data on a new push-pull selector switch that provides a single point of control for multiple-operation machines. 24

Quenching Oil Purification

HONAN-CRANE CORPORATION, 912 Sixth St., Lebanon, Ind. Bulletin discussing two case histories involving the purification of quenching oil and the savings made through the use of Honan-Crane equipment. 25

Pneumatic and Hydraulic Cylinders

LEDEEN MFG. CO., 1600 S. San Pedro St., Los Angeles 15, Calif. Bulletin 500, giving dimensions, weights, ratings, etc., for the company's line of pneumatic and hydraulic actuating cylinders. 26

Coolants

F. E. ANDERSON OIL CO., Portland, Conn. Circular describing "Lusol," a new coolant for use in all types of machining and grinding operations. Includes case histories of savings effected by the use of this coolant. 27

Turret Trucks

HYSTER CO., Portland 8, Ore. Circular 1138, describing five models of turret trucks formerly manufactured by the Salsbury Corporation of Los Angeles and now taken over by Hyster Co. 28

Self-Locking Rings

WALDES KOHINOOR, INC., TRUARC SALES DIVISION, 47-16 Austel Place, Long Island City 1, N. Y. Bulletin 5, containing engineering specifications and data on self-locking retaining rings. 29

Radiant Burners

SELAS CORPORATION OF AMERICA, Erie Ave. and D St., Philadelphia 34, Pa. Bulletin S-1, S-1.1, describing industrial heat processing techniques with radiant gas burners, which combine high speed of heating with precise control. 30

Electronic Controls

PHOTOSWITCH, INC., 77 Broadway, Cambridge 42, Mass. Bulletin PG 4910, entitled "Cutting Production Costs with Electronic Controls," containing forty-five case studies of electronic control applications. 31

Speed Reducers

DODGE MFG. CORPORATION, Mishawaka, Ind. Bulletin A-470, containing tables designed to simplify the selection of the new Dodge "Torque-Arm" speed reducer for various applications. 32

Shear-Knife Handbook

HEPPENSTALL CO., 4620 Hatfield St., Pittsburgh 1, Pa. Handbook on shear knives containing 48 pages of information of values to those who use, buy, or grind metal-cutting shear knives. 33

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D. O. JAMES GEAR MFG. CO., 1140 W. Monroe St., Chicago 7, Ill. Bulletins showing typical examples of the company's line of gear speed reducers of the motorized and non-motorized types. ... 34

Wheel Crushing Unit

JERPBAK BAYLESS CO., 155 Bell St., Chagrin Falls, Ohio. Leaflet describing a new portable motor-driven wheel crushing unit designed for use with surface or cylindrical grinders. 35

Dovetail Type Boring Heads

FLYNN MFG. CO., 443 Bates St., Detroit 26, Mich. Circular announcing two new dovetail type boring heads, especially designed for small jig borers, turret lathes, and light milling machines. 36

Motors and Generators

JANETTE MFG. CO., 556 W. Monroe St., Chicago 6, Ill. Bulletin 15-1, describing the performance and construction features of the company's line of motors and generators. 37

Production Grinding Machines

MATTISON MACHINE WORKS, Rockford, Ill. Bulletin 145-3RM, descriptive of Hanchett duplex rotary type surface grinding machines recently taken over by the company. 38

Inside Micrometers

RIMAT MACHINE TOOL CO., 1117 Air Way, Glendale 1, Calif. Bulletin R-3, listing the line of inside micrometers made by the company, together with their measuring ranges. 39

Air Cylinders

RIVETT LATHE & GRINDER, INC., Brighton 35, Boston, Mass. Catalogue Section No. 54, covering the line of Gerotor double-acting, non-rotating air cylinders. 40

Lock-Pins

DRIV-LOK PIN CO., Sycamore, Ill. Catalogue describing the principle of design and the application of Driv-Lok pins designed to facilitate assembling. 41

Electric Motors

GENERAL ELECTRIC CO., Schenectady 5, N. Y. Bulletin GEA-5332, descriptive of G-E low-speed synchronous motors for efficient, high-power factor, constant-speed drives. 42

Precision Bench Lathes

SOUTH BEND LATHE WORKS, South Bend 22, Ind. Catalogue L-10, illustrating and describing a new series of South Bend "Light Ten" precision bench lathes and attachments. 43

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NATIONAL TWIST DRILL & TOOL CO., Rochester, Mich. Pamphlet listing dimensions and prices of National "Helex" short-series, fast-spiral, end-mills. 44

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JOHNSON BRONZE CO., New Castle, Pa. Catalogue L-5, containing a condensed list of the most commonly used sizes of "Ledaloyl" self-lubricating bronze bearings. 45

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READY TOOL CO., 550 Iranistan Ave., Bridgeport 5, Conn. Bulletin introducing the new "Red E" reversible grinding machine dog. 46

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BAUSCH & LOMB OPTICAL CO., Rochester 2, N. Y. Catalogue D-185, descriptive of Bausch & Lomb laboratory microscopes. .. 47

Work-Benches

STANDARD PRESSED STEEL CO., Jenkintown 19, Pa. Bulletin 701, on Hallowell work-benches. 48

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